

# ZEXEL

## FOREWORD

This service manual has been prepared for the purpose of assisting service personnel in providing efficient and correct service and maintenance on the two-spring nozzle holder assembly for diesel engines.

This manual includes procedures for adjustments, disassembly and reassembly of components.

The contents of this manual, including illustrations, drawings, and specifications, are the latest available at the time of printing.

The right is reserved to make changes in specifications and procedures at any time without notice.

Nozzle holder for ISUZU                      A 01 →

Nozzle holder for HONDA                    D 01 →



## FEATURES

The two-spring nozzle holder has been developed by Diesel Kiki in response to regulations controlling the quantity of NOx (nitrogen oxides) in exhaust gas. This design is suitable for direct injection diesel engines.

Due to retardation of the injection timing to meet NOx regulations, the engine output becomes insufficient. When the fuel injection rate is increased to improve the engine output, the high rate of injection results in irregular injection\* at low speed and low load levels. This irregular injection causes "knocking" and surge.

The two-spring nozzle holder throttles the injection quantity at the initial stage of nozzle opening by controlling needle valve lift. Main injection results when the injection pipe's in-line pressure has increased sufficiently. The throttling of the injection quantity significantly decreases irregular injection, therefore decreasing noise and "knocking" at low to intermediate speeds.

In the future it is expected that more and larger engines will adopt the two-spring nozzle holder.

### \*Irregular Injection

: A phenomenon whereby the fuel injection quantity varies when the residual pressure in the injection pipe changes.



## CONSTRUCTION

The two-spring nozzle holder incorporates two individual springs and two pushrods.

A clearance, termed "pre-lift", is provided between the two pushrods.

The nozzle opening pressure is fixed by the first spring. When the nozzle is opened, the needle valve is lifted the amount of the previously determined pre-lift.

When the injection pipe's in-line pressure exceeds the resultant force of both springs, the two pushrods contact and the needle valve is again lifted, resulting in a fully opened nozzle. To adjust the nozzle opening pressure, an adjusting shim is installed with the first spring.

The force of the second spring is adjusted by an adjusting screw.

The application of the two-spring nozzle holder is the same as that of the conventional nozzle holder.

**A3**

Construction

Two-spring nozzle holder



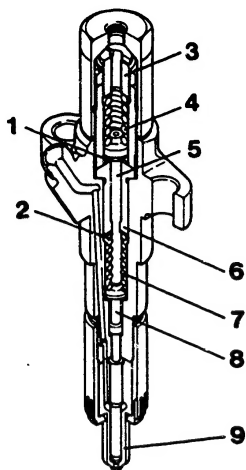


Fig. 1

- 1 = Shim  
(for adjusting pre-lift)
- 2 = Shim  
(for adjusting nozzle opening pressure)
- 3 = Adjusting screw
- 4 = Second spring
- 5 = Second pushrod
- 6 = Spacer
- 7 = First spring
- 8 = First pushrod
- 9 = Nozzle



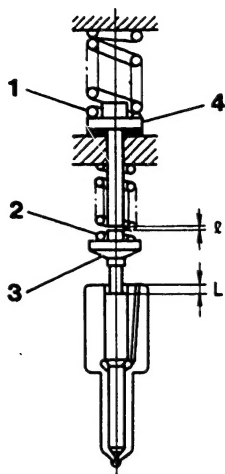


Fig. 2

- 1 = Second spring
- 2 = First spring
- 3 = First pushrod
- 4 = Second pushrod

L : needle valve's full-lift  
 l : needle valve's pre-lift

**A5**

Construction

Two-spring nozzle holder



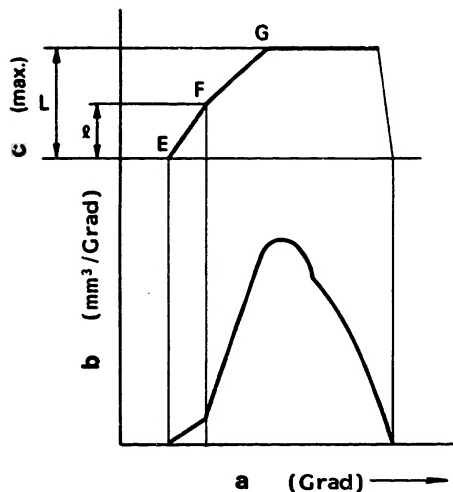


Fig. 3

a = Lift  
b = Injection rate  
c = Cam angle

L : needle valve's full-lift  
ℓ : needle valve's pre-lift  
A - B : first spring's set force  
B - C - D : resultant force of first and second springs  
P<sub>1</sub> : nozzle opening pressure  
P<sub>2</sub> : injection pressure after pilot injection

#### OPERATION

When the fuel pressure from the injection pipe exceeds the set force of the first spring, the needle valve and first pushrod are pushed up and the valve is opened (point E of Fig. 3 and point A of Fig. 4).

When the first pushrod is lifted through the pre-lift and contacts the second pushrod, the needle valve temporarily stops (point F of Fig. 3 and Section B - C of Fig. 4).

When the fuel pressure exceeds the resultant force of the first and second springs, the needle valve is again pushed up and main injection results.

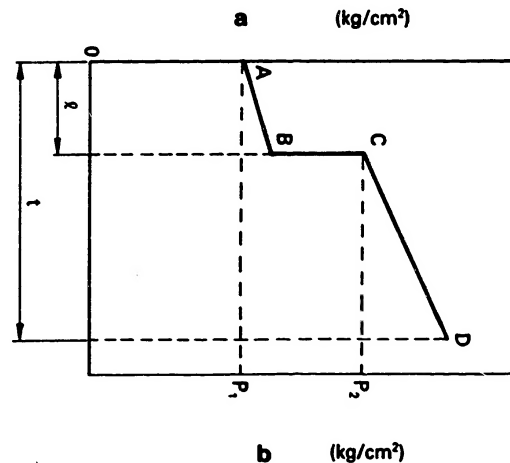


Fig. 4

a = Set force of spring  
b = Injection pressure

A6

Operation  
Two-spring nozzle holder



A7

Operation  
Two-spring nozzle holder



## SPECIAL TOOLS

The following special tools are required for disassembly, reassembly and adjustment of the two-spring nozzle holder.

Key No.	Part No.	Tool Name	Remarks
1/1	0 684 200 704	Nozzle Tester	
1/2	1 687 231 211	Pressure Gauge	Maximum scale: 0 - 400 bar
1/3	KDDC 0019	Test Line	M12 x 1.5, M14 x 1.5, 200 mm
1/4	KDDC 0020	Test Line	M14 x 1.5, M14 x 1.5, 200 mm
2	KDEP 2651	Adjusting Device Ass'y	For adjusting needle valve pre-lift (for KBL II-S type two-spring nozzle holder)
2/1	KDEP 2651/1	Adjusting Device	
2/2	1 687 233 010	Dial Gauge	Measuring range: 0 to 10 mm x 0.01 mm
2/3	KDEP 2651/3	Base	For setting adjusting device's "0" point
2/4	KDEP 2651/2	Pin	60.5 mm long
3	0 681 200 704	Nozzle Cleaning Kit	
4	Commercially Available	Torque Wrench	
5	Commercially Available	Torque Spanner	SW 17 mm
6	Commercially Available	Socket Wrench	For tightening retaining nut, SW 19 mm
7	KDEP 2653	Plate	For fixing KBL II-S type two-spring nozzle holder
8	KDEP 2652	Adjusting Device Ass'y	For adjusting needle valve pre-lift (for KBDL II-P type two-spring nozzle holder)
8/1	KDEP 2652/1	Adjusting Device	
8/2	1 687 233 010	Dial Gauge	Measuring range: 0 to 10 mm x 0.01 mm
8/3	KDEP 2652/2	Pin	60.4 mm long
8/4	KDEP 2652/3	Base	For adjusting device's "0" setting
9	KDEP 2654	Plate	For fixing KBDL II-P type two-spring nozzle holder
10	KDEP 2655	Scraper	For cleaning DLLA-P nozzle's valve seat
11	KDEP 2656	Scraper	For cleaning DLLA-P nozzle's fuel oil chamber

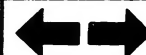
Note: Any conventional nozzle testers can be used when their pressure gauge is replaced with the above pressure gauge (157955-2000, Key No. 1/2).

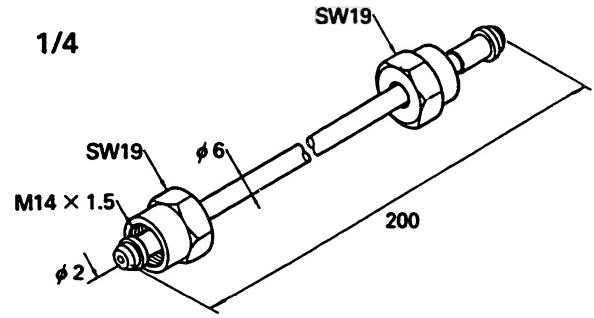
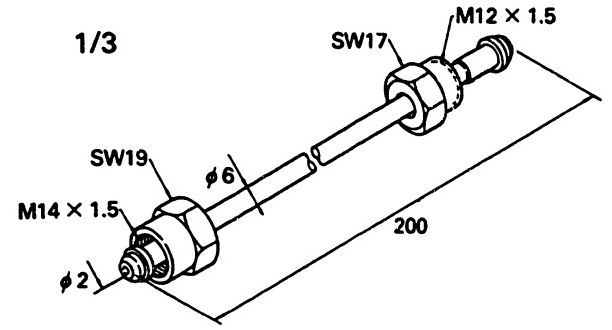
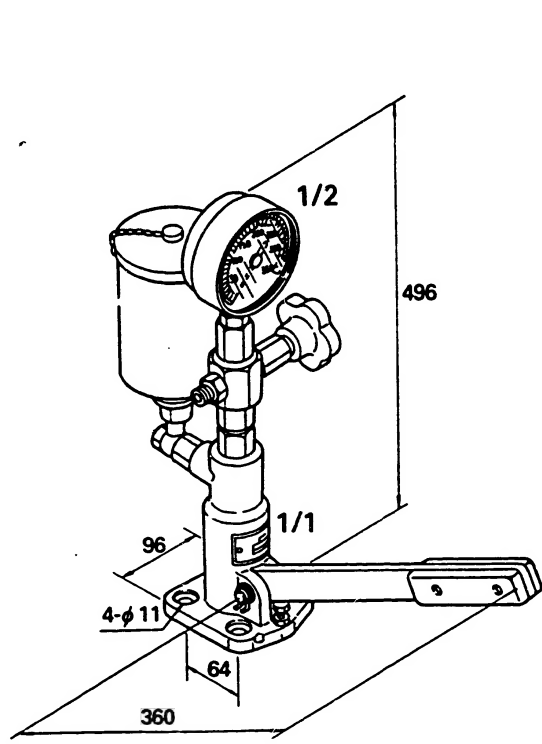
**A8**

Special tools  
Two-spring nozzle holder


**A9**

Special tools  
Two-spring nozzle holder





Unit: mm

Fig. 5-1 Special tools

1/1 = Nozzle tester  
1/2 = Pressure gauge

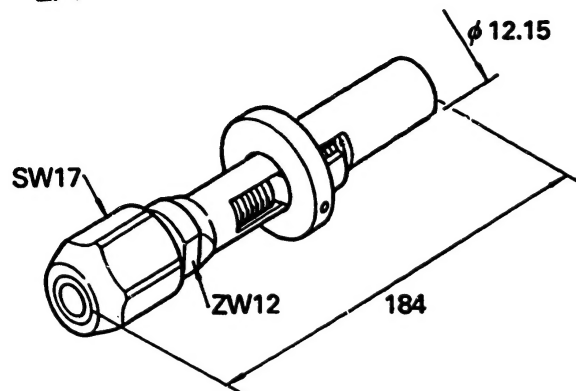
1/3 = Test line  
1/4 = Test line

<b>A10</b>	Special tools	↔
	Two-spring nozzle holder	

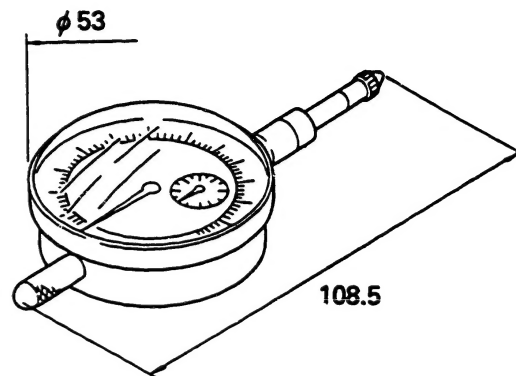
<b>A11</b>	Special tools	↔
	Two-spring nozzle holder	



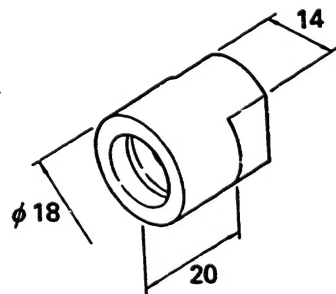
2/1



2/2



2/3



2/4

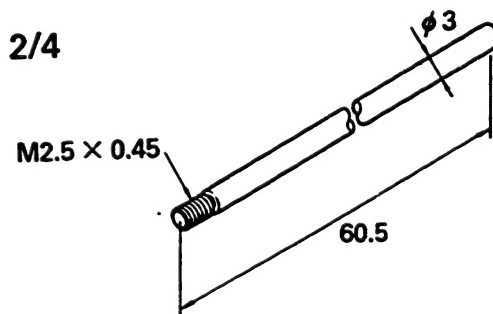


Fig. 5-2 Special tools

2/1 = Adjusting device

2/2 = Dial gauge

2/3 = Base

2/4 = Pin

Unit: mm

**A12**

Special tools

Two-spring nozzle holder

**A13**

Special tools

Two-spring nozzle holder



3

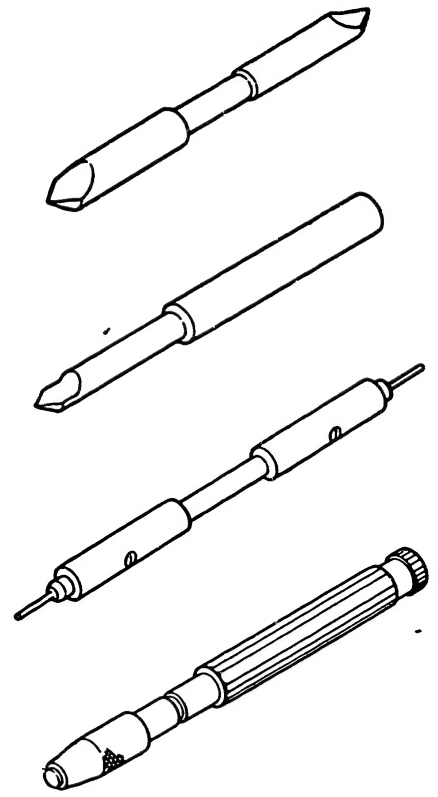
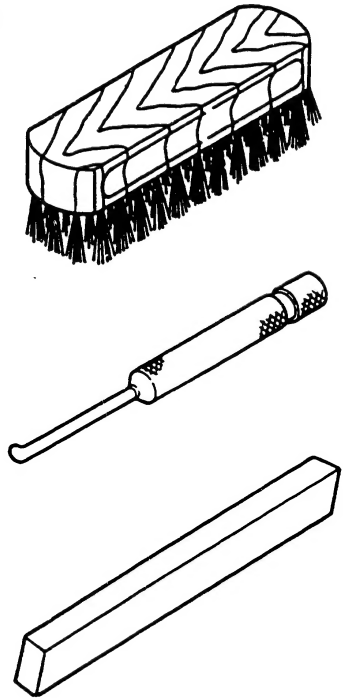


Fig. 5-3 Special tools

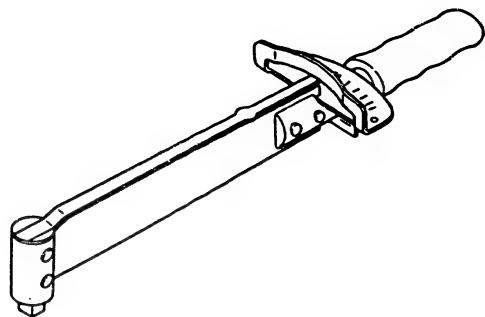
3 = Nozzle cleaning kit

Unit: mm

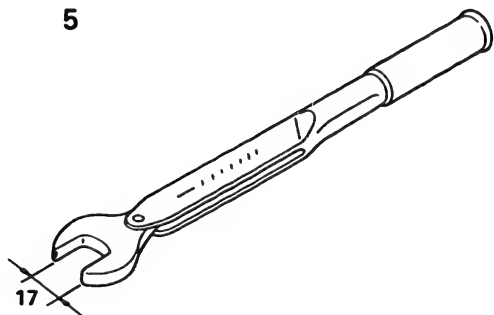
<b>A14</b>	Special tools	
	Two-spring nozzle holder	

<b>A15</b>	Special tools	
	Two-spring nozzle holder	

4



5



6

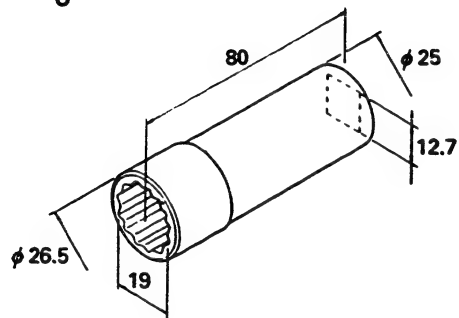


Fig. 5-4 Special tools

4 = Torque wrench  
5 = Torque wrench

6 = Socket wrench

Unit: mm

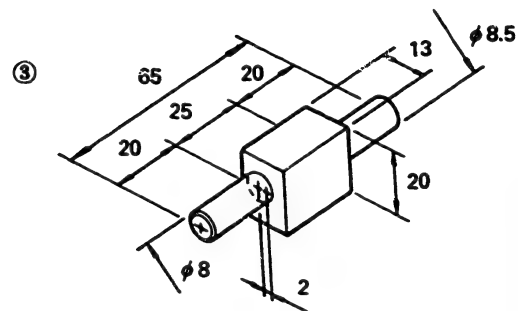
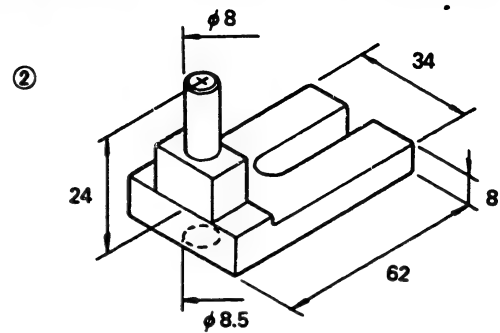
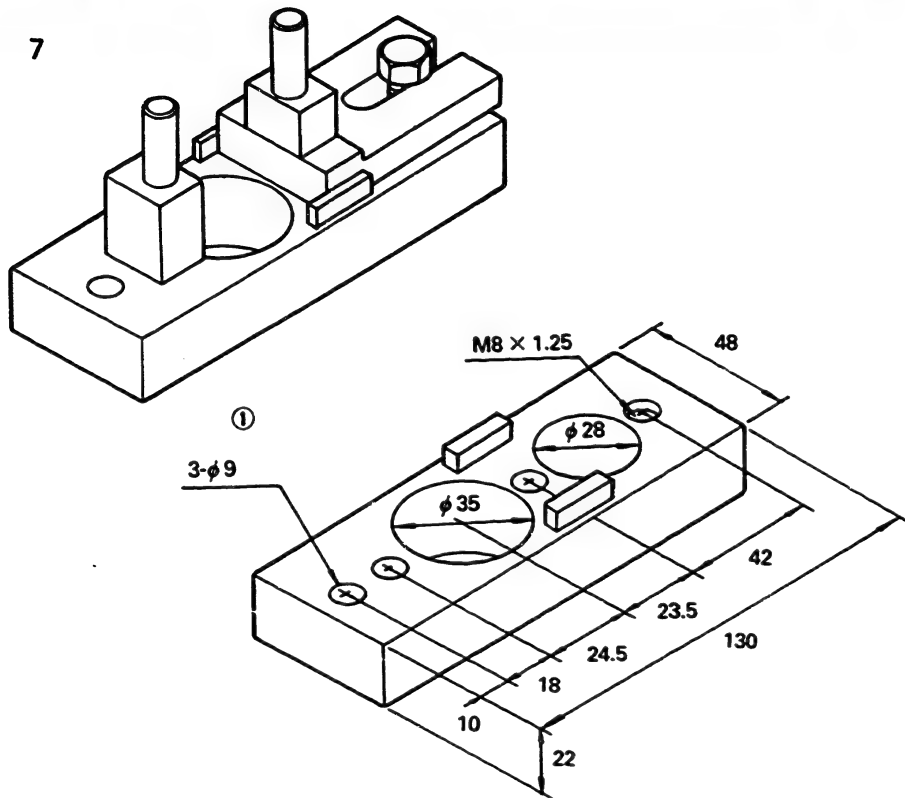


Fig. 5-5 Special tools

Unit: mm

7 = Plate

<b>A18</b>	Special tools	↔
	Two-spring nozzle holder	

<b>A19</b>	Special tools	↔
	Two-spring nozzle holder	

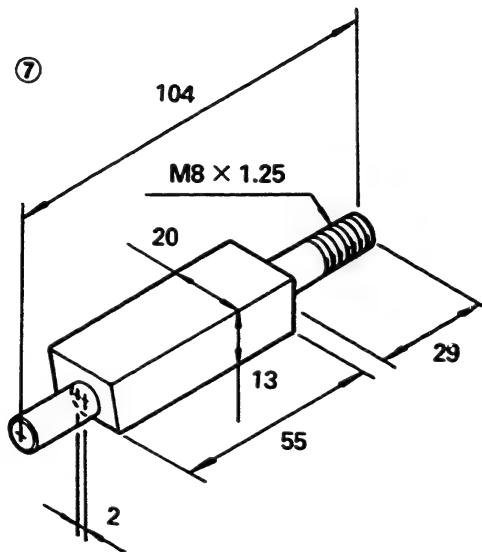
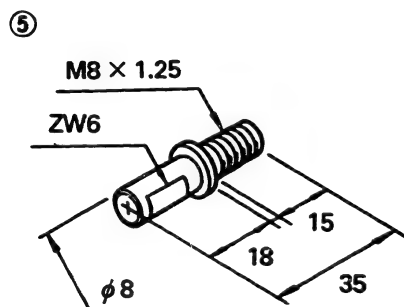
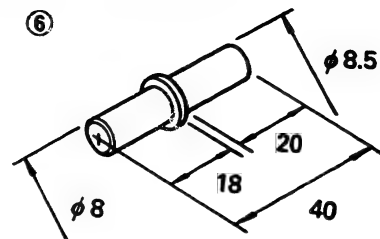
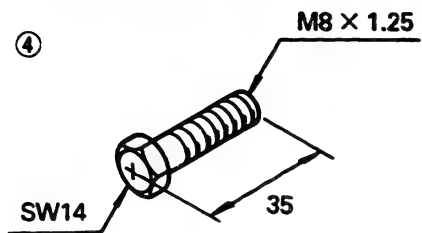


Fig. 5-6 Special tools

Unit: mm

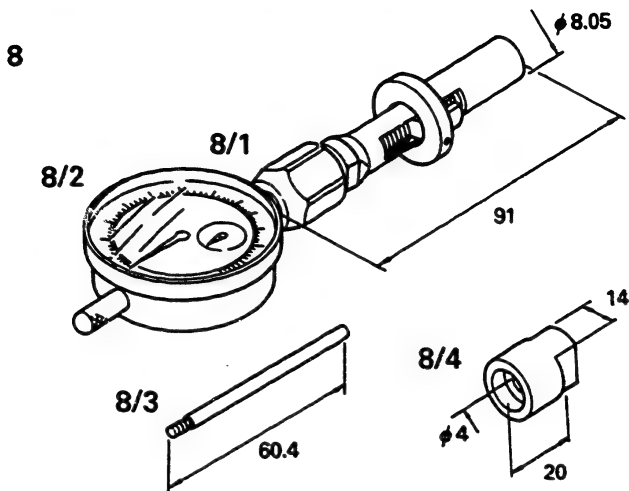


Fig. 5-7 Special tools

Unit: mm

8 = Adjusting device Ass'y

8/1 = Adjusting device

8/2 = Dial gauge

8/3 = Pin

8/4 = Base

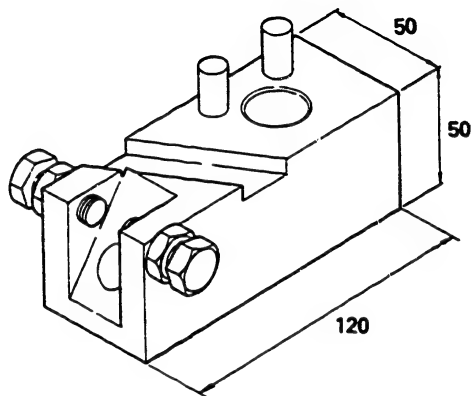
**A22**

Special tools

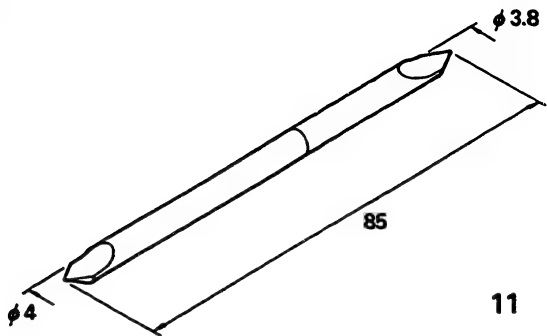
Two-spring nozzle holder



9



10



11

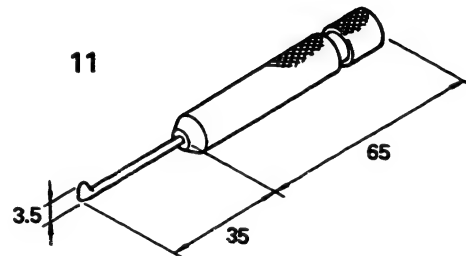


Fig. 5-8 Special tools

Unit: mm

9 = Plate

10 = Scraper

11 = Scraper



Fig. 6 Nozzle cleaning

#### DISASSEMBLY

Disassembly of the nozzle and nozzle holder should be performed after pre-cleaning.

- Note: 1. Dip the nozzle holder into a suitable cleaner to attain good cleaning results.
2. Part names which follow the circled numbers refer to Figure 7.





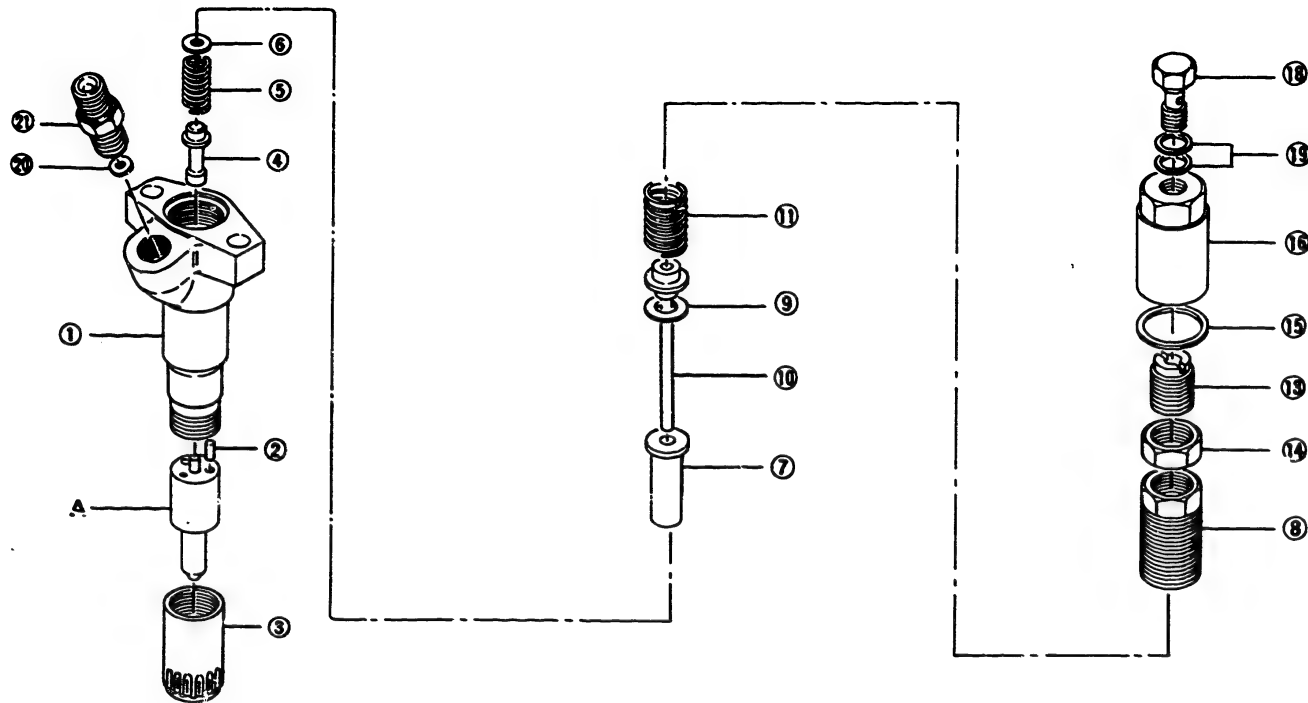


Fig. 7 Part Name

- ① = Body (nozzle holder)
- ② = Pin
- ③ = Retaining nut
- ④ = Pushrod (first)
- ⑤ = Spring (first)
- ⑥ = Shim

- ⑦ = Spacer
- ⑧ = Set screw
- ⑨ = Shim
- ⑩ = Pushrod (second)
- ⑪ = Spring (second)
- ⑬ = Adjusting screw
- ⑭ = Nut

- ⑮ = Gasket
- ⑯ = Capnut
- ⑰ = Eyebolt
- ⑱ = Gasket
- ⑳ = Gasket
- ㉑ = Inlet connector
- A = Nozzle

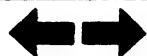
**A26**

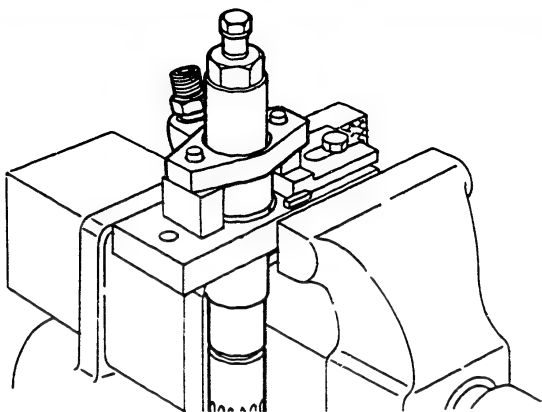
Disassembly  
Two-spring nozzle holder



**A27**

Disassembly  
Two-spring nozzle holder





**Fig. 8 Positioning the nozzle holder**

**1 = Position the nozzle and nozzle holder assembly on the plate (Part No. KDEP 2653).**

**A28**

Disassembly

Two-spring nozzle holder



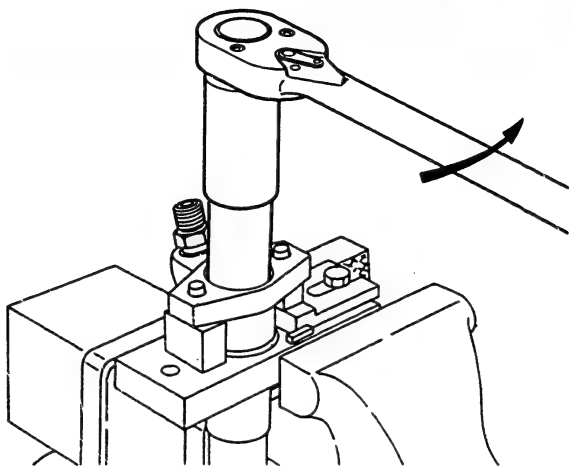


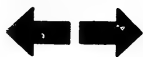
Fig. 9 Capnut removal

2. Remove the capnut (16) and gasket (15).

**B1**

Disassembly

Two-spring nozzle holder



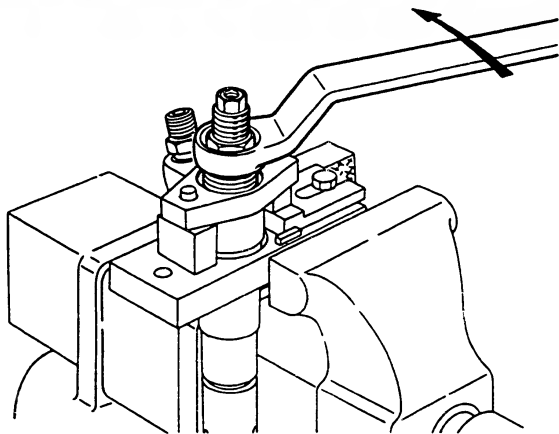


Fig. 10 Locknut removal

3. Remove the locknut (14).

**B2**

Disassembly

Two-spring nozzle holder



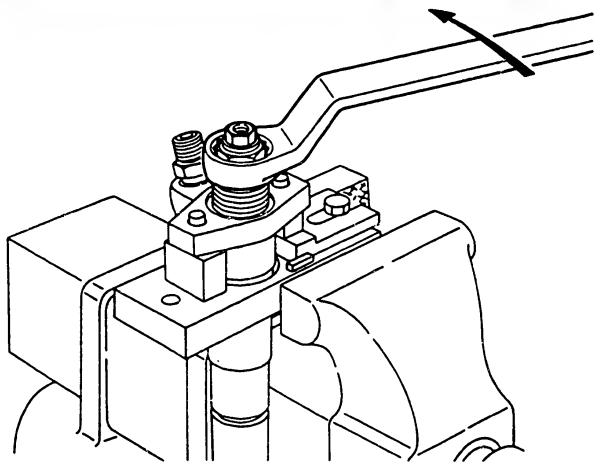


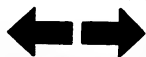
Fig. 11 Set screw removal

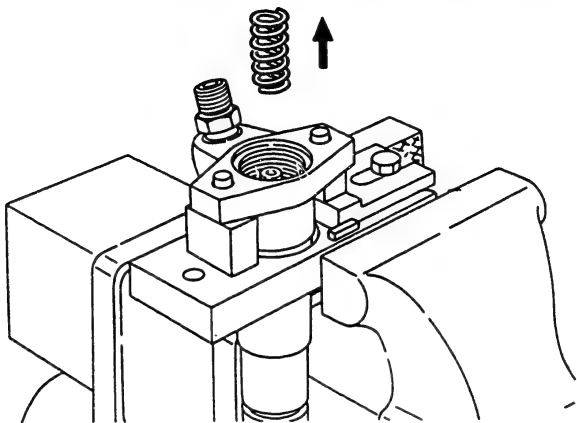
4. Remove the set screw (8) and adjusting screw (13).

**B3**

Disassembly

Two-spring nozzle holder





**Fig. 12 Second spring removal**

- 5. Remove the second spring (11).**

**B4**

**Disassembly**

**Two-spring nozzle holder**



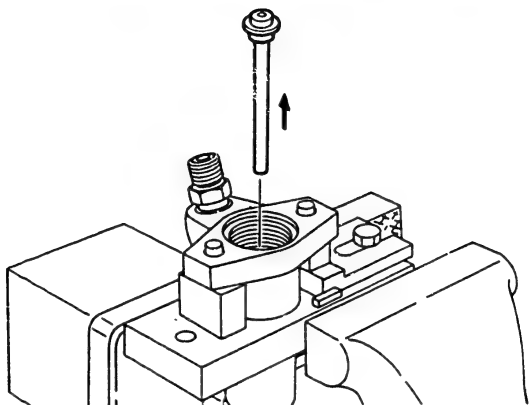


Fig. 13 Second pushrod removal

6. Remove the second pushrod (10).

**B5**

Disassembly

Two-spring nozzle holder



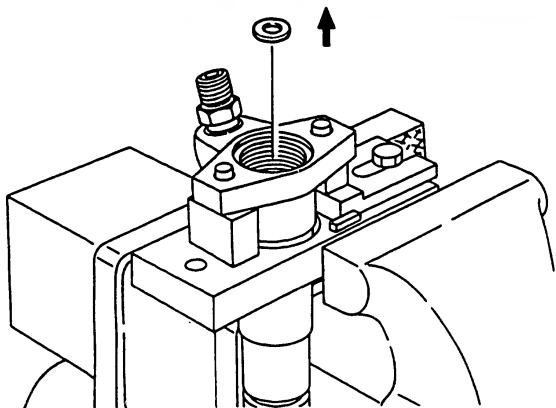
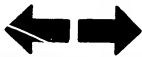


Fig. 14 Adjusting shim removal

7. Remove the pre-lift adjusting shim (9).

**B6**

Disassembly  
Two-spring nozzle holder





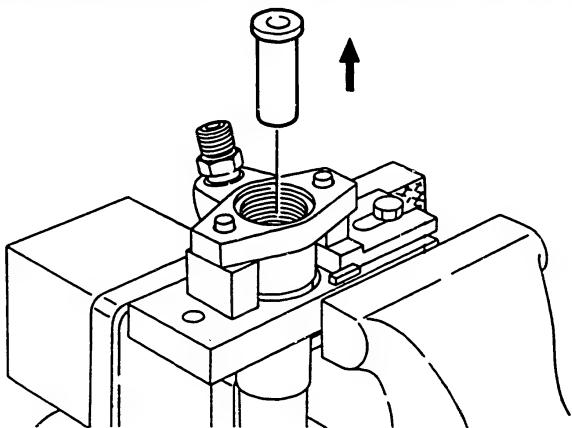


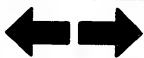
Fig. 15 Spacer removal

8. Remove the spacer (7).

**B7**

Disassembly

Two-spring nozzle holder



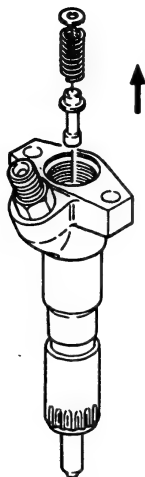


Fig. 16 Shim, spring and pushrod removal

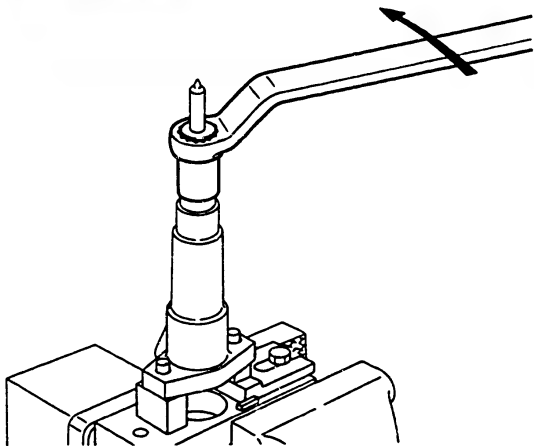
9. Remove the nozzle holder from the plate, and then remove the shim (6), first spring (5), and first pushrod (4) from the holder.

**B8**

Disassembly

Two-spring nozzle holder





**Fig. 17 Retaining nut removal**

10. Position the nozzle holder on the plate, and remove the retaining nut (3). (Fig. 17).
11. Thoroughly clean all parts in a suitable cleaner.
12. Remove carbon with the cleaning kit (Part No. KDEP 2900).

**Note:** Use a proper cleaning kit to remove excess carbon, and wash all parts in clean oil.

13. Visually inspect all parts for damage caused by mishandling, abrasion or corrosion, etc.

**B9**

Disassembly

Two-spring nozzle holder



## REASSEMBLY

Two-spring nozzle holder reassembly is the reverse of disassembly, as in the case of conventional nozzle holders. However, the two-spring nozzle holder requires adjustment during assembly.

Reassemble and adjust the two-spring nozzle holder in accordance with the procedure described below. Special attention should be paid to prevention of misalignment between the nozzle and retaining nut.

**B10**

Reassembly

Two-spring nozzle holder



## ADJUSTMENT

Adjustment must be performed during reassembly. Unlike conventional nozzle holders, complicated and delicate adjustments are required. Therefore, it is necessary to use special measuring instruments and to follow the procedure given below.

As adjustment of pre-lift is made in hundredths of a millimeter, all parts must be thoroughly cleaned and washed in light oil to remove all dirt and foreign matter before beginning reassembly.

- Note: 1. Specified values are included on the micro film #PND-002.
2. It is recommended that reassembly be performed adjacent to the nozzle tester to insure proper reassembly and adjustment.
  3. "Second Nozzle Opening Pressure Adjustment", which is described in this manual, is the adjustment of the setting force of the second spring.

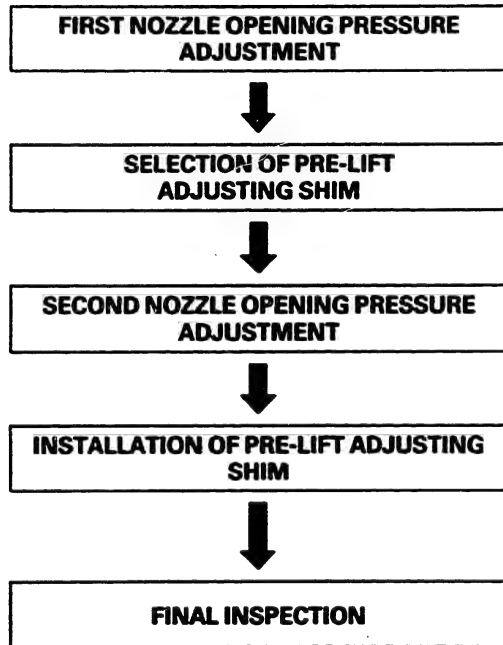
**B11**

Adjustment

Two-spring nozzle holder



Outline of adjusting procedure



**Step 1**

Adjust the first nozzle opening pressure with the shim ⑥. See coord. B 15.

**Step 2**

Determine the thickness of the pre-lift adjusting shim ⑨ and select the proper size. See coord. B 22.

**Step 3**

Adjust the second nozzle opening pressure with the adjusting screw ⑬. See coord. C 6.

**Step 4**

From this stage the adjustment is performed with the pre-lift shim at the proper position.

**NOTE:** Do not set the shim during Step 1 - 3. See coord. C 9 - C 11.

**Step 5**

Confirm the condition of the fuel spray etc., with the nozzle and nozzle holder assembled.

See coord. C 13 - C 14.

**B12**

Adjustment

Two-spring nozzle holder



**B13**

Adjustment

Two-spring nozzle holder



The adjustment procedure of the KBL II-S type two-spring nozzle holder is described below, using nozzle holder Part No. 105100-5570\* as an example.

Two-spring nozzle holder (105100-5570)\* specifications.

First nozzle opening pressure

Specified value: 180 kg/cm<sup>2</sup>

Adjusted value: 180 - 188 kg/cm<sup>2</sup>

Second nozzle opening pressure

Specified value: 220 kg/cm<sup>2</sup>

Adjusted value: 253 - 259 kg/cm<sup>2</sup>

Nozzle's full-lift: 0.3 mm

Nozzle's pre-lift: 0.1 mm

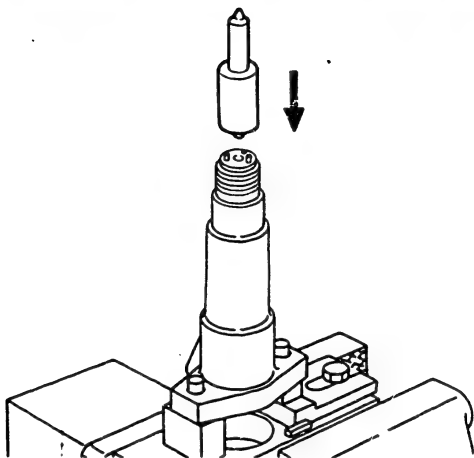
\* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31.

**B14**

Adjustment

Two-spring nozzle holder





**Fig. 18 Positioning the nozzle**

**1. FIRST NOZZLE OPENING PRESSURE ADJUSTMENT**

- 1. Secure the plate (Part No. KDEP 2653) in a vise.**
- 2. Position the nozzle holder body on the plate with the capnut side down.**
- 3. Position the nozzle on the nozzle holder by inserting the two nozzle holder locating pins into the holes in the nozzle. (Fig. 18).**

**B15**

**First nozzle opening pressure adjustment**  
**Two-spring nozzle holder**





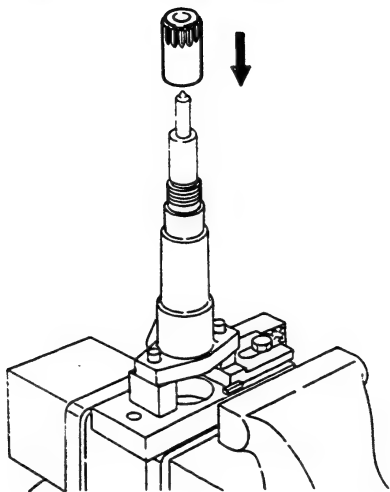


Fig. 19 Retaining nut installation

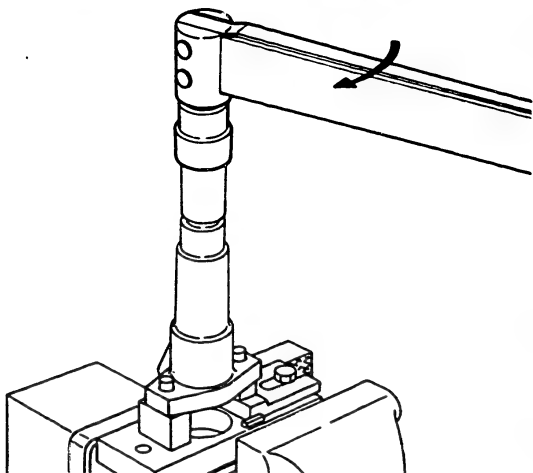
4. Install the retaining nut.

**B16**

First nozzle opening pressure adjustment

Two-spring nozzle holder





**Fig. 20** Tightening the retaining nut

5. Tighten the retaining nut to the specified torque with a socket wrench (Part commercially available) and a torque wrench. (Fig. 20).

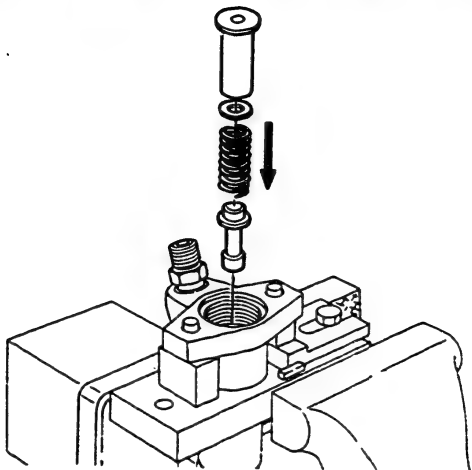
Specified torque: 6 - 8 kg-m

**B17**

First nozzle opening pressure adjustment

Two-spring nozzle holder





**Fig. 21 Pushrod, spring, shim and spacer installation**

6. Position the nozzle holder on the plate with the capnut side up.
7. Install the first pushrod (4), first spring (5), and shim (6).
8. Install the spacer (7). (Fig. 21).

**B18**

First nozzle opening pressure adjustment

Two-spring nozzle holder



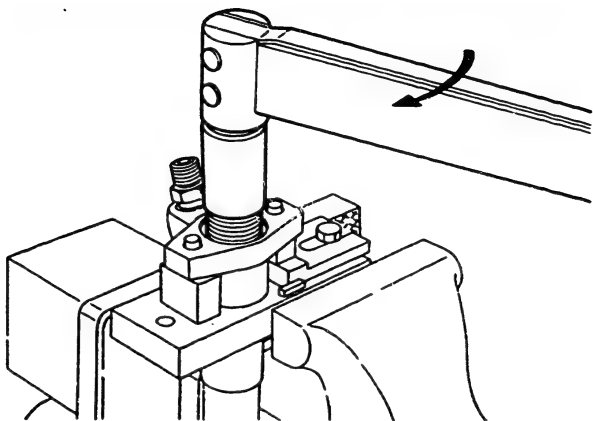


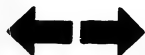
Fig. 22 Tightening the set screw

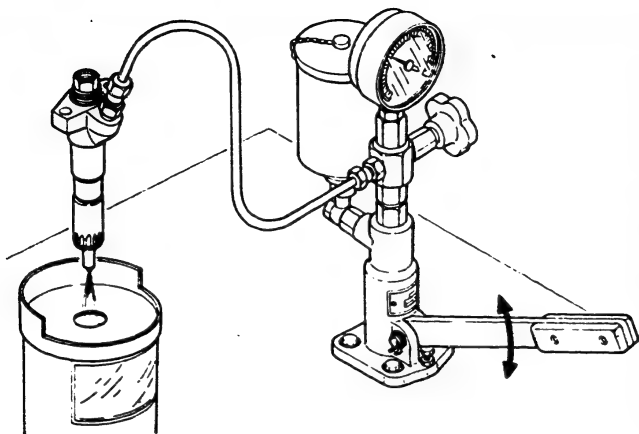
9. Tighten the set screw (8) to the specified torque with the socket wrench and a torque wrench. (Fig. 22).

Specified torque: 5 - 6 kg-m

**B19**

First nozzle opening pressure adjustment  
Two-spring nozzle holder





**Fig. 23** Checking first nozzle opening pressure

10. Confirm that the first nozzle opening pressure is within the adjusted range using the nozzle tester (Part No. 1 684 200 704). (Fig. 23).

When the pressure is not as specified, replace the shim and readjust. Adjusting shims are shown below.

Adjusted pressure: 180 - 188 kg/cm<sup>2</sup>



Note: 1. A shim thickness of 0.02 mm corresponds to a nozzle opening pressure of 2.35 kg/cm<sup>2</sup>.

2. Two shims can be used if necessary.

#### Adjusting shims

Thickness (mm)	Part No. *
0.50	150523-5000
0.52	150523-5100
0.54	150523-5200
0.56	150523-5300
0.58	150523-5400
0.60	150523-5500
0.70	150523-6000
0.80	150523-6500
0.90	150523-7000
1.00	150523-7500
0.10	150532-6700
0.20	150532-6800
0.30	150532-6900
0.40	150532-7000

\* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31.

**B21**

First nozzle opening pressure adjustment

Two-spring nozzle holder



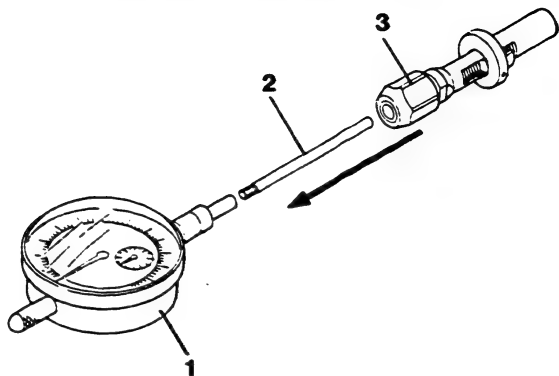


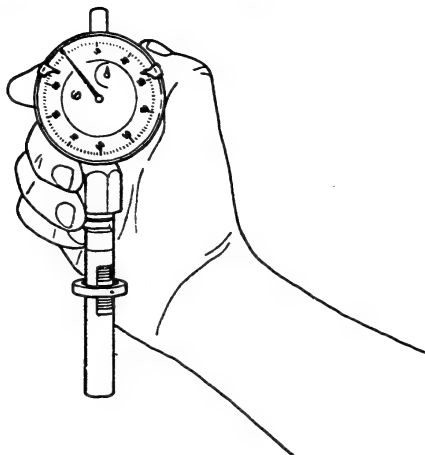
Fig. 24 Inserting the pin

- 1 = Dial gauge
- 2 = Pin
- 3 = Adjusting device

## 2. SELECTION OF PRE-LIFT ADJUSTING SHIM

1. Insert a 60.5 mm pin (Part No. KDEP 2651/2) into the dial gauge (Part No. 1 687 233 010). (Fig. 24).





**Fig. 25** Setting the dial gauge

2. Position the dial gauge on the adjusting device (Part No. KDEP 2651/1).

**B23**

Selection of pre-lift adjusting shim  
Two-spring nozzle holder





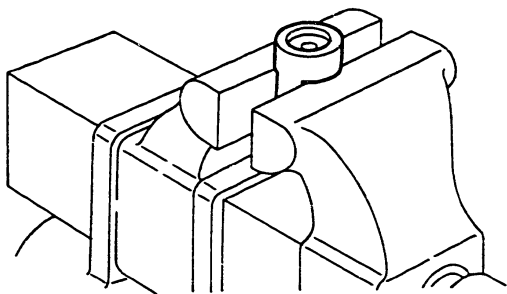


Fig. 26 Positioning the base

3. Position the base (Part No. KDEP 2651/3) in the vise.

**B24**

Selection of pre-lift adjusting shim

Two-spring nozzle holder



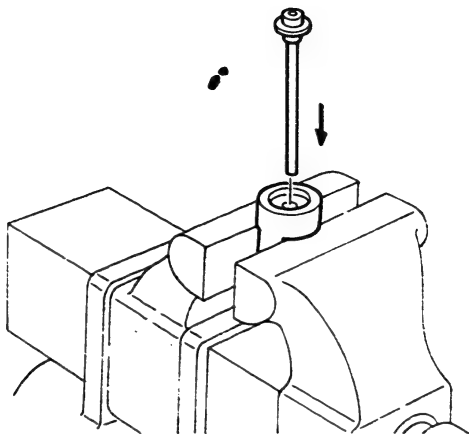


Fig. 27 Inserting the second pushrod

4. Insert the second pushrod (10) into the base.

**B25**

Selection of pre-lift adjusting shim

Two-spring nozzle holder



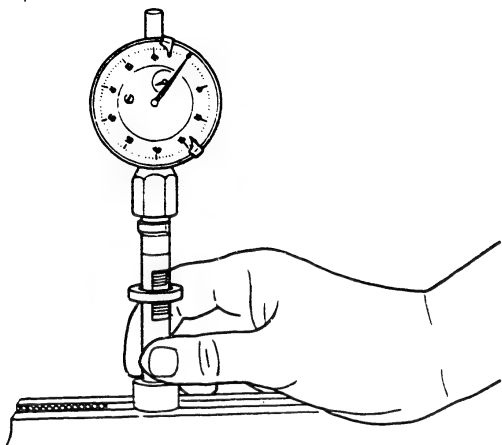


Fig. 28 "0"-point adjustment

5. Position the adjusting device on the base as shown in Fig. 28, and set the dial gauge to "0" while the adjusting device is pushed down.

**CAUTION!**

1. Confirm the "0" setting several times.
2. After setting the "0" point, handle the adjusting device carefully so that the "0"-point will not be disturbed.



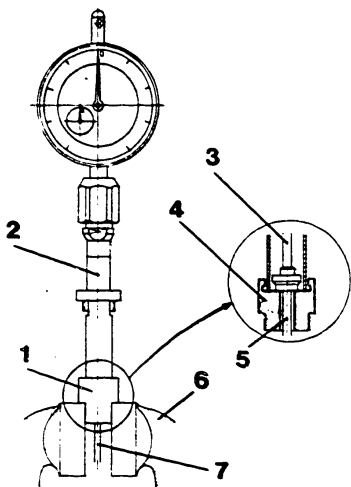


Fig. 29 Sectional diagram of Fig. 28

- 1 = Base
- 2 = Adjusting device
- 3 = Pin for adjusting device
- 4 = Base
- 5 = Second pushrod
- 6 = Vise
- 7 = Second pushrod



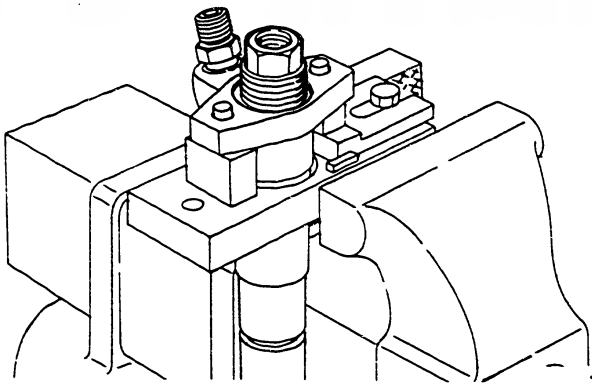


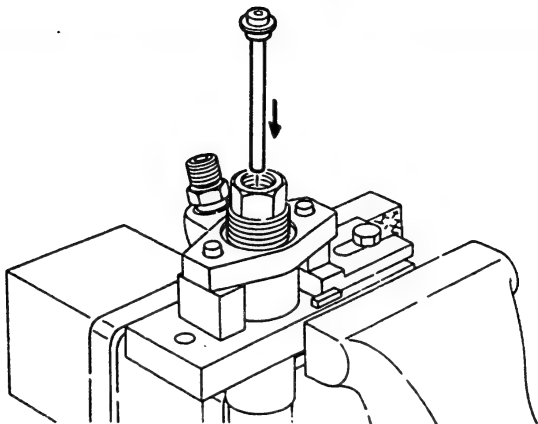
Fig. 30 Positioning the nozzle holder

6. Position the nozzle holder on the plate.

**B28**

Selection of pre-lift adjusting shim  
Two-spring nozzle holder





**Fig. 31** Inserting the second pushrod

**7.** Insert the second pushrod (10) into the nozzle holder.

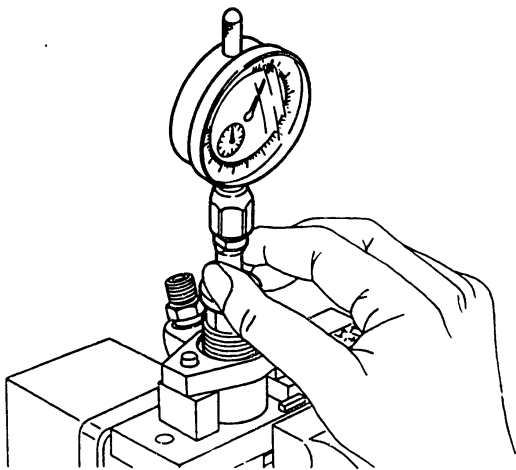
**Note:** Do not install the second spring (11) and pre-lift shim (9) at this time.

**C1**

Selection of pre-lift adjusting shim

Two-spring nozzle holder





**Fig. 32 Measuring lift "h"**

**8. Insert the adjusting device into the set screw (8).**

**Note: Tighten the adjusting device at the intermediate position, and confirm that the dial gauge moves smoothly.**

**9. Push the adjusting device down as shown in Fig. 32, and measure the lift (h).**

**Note: Measure the value to within 0.01 mm.**



10. Calculate the thickness (T) of the pre-lift shim to be installed, as shown below.

T: Thickness of shim to be actually selected,

$$T = t \pm 0.015 \text{ mm}$$

$$t = \ell + h$$

t: Thickness of shim (measured value),

$\ell$ : Pre-lift value (specified value)

h: h-measurement, explained in Step 2 — 9 above.

**Note:** Select a suitable shim from the table in Step 1 — 10.

**[EXAMPLE]**

When the h-measurement is 0.98 mm.

$$t = 0.1 + 0.98 = 1.08, \text{ therefore}$$

$$T = 1.08 \pm 0.015 = 1.065 \sim 1.095$$

**The shims (Part No. 150523-5000\* and 150523-5400)\*, which together are 1.08 mm thick, are used.**

**Note:** 1. Two shims can be used.

2. Do not install the shim(s) at this time.

11. Remove the adjusting device.

**\*) Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31.**

**C3**

Selection of pre-lift adjusting shim

Two-spring nozzle holder





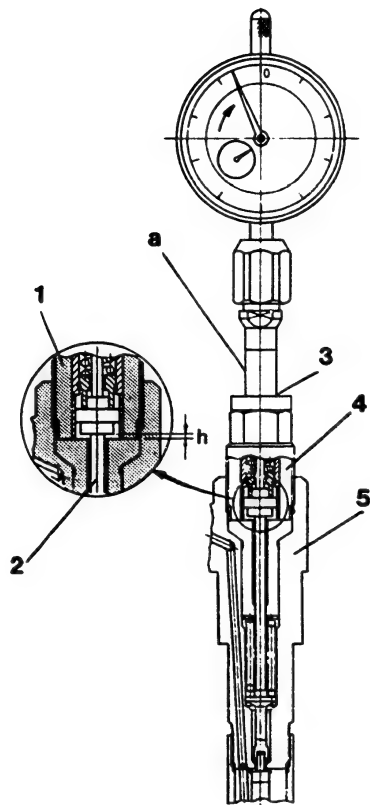


Fig. 33 Sectional diagram of Fig. 32

- 1 = Set screw
- 2 = Second pushrod
- 3 = Adjusting device's intermediate screw

- 4 = Set screw
- 5 = Nozzle holder

a = Hold this part when moving the dial gauge up and down.

**C4**

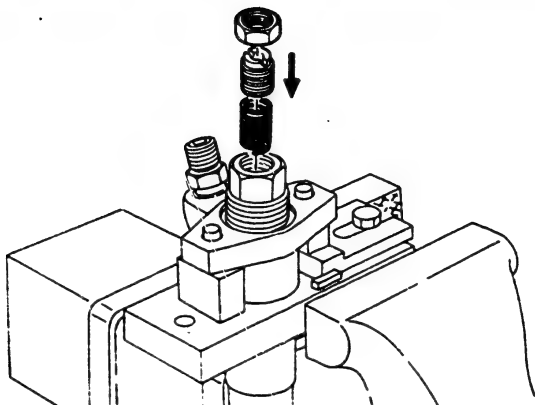
Selection of pre-lift adjusting shim  
Two-spring nozzle holder



**C5**

Selection of pre-lift adjusting shim  
Two-spring nozzle holder





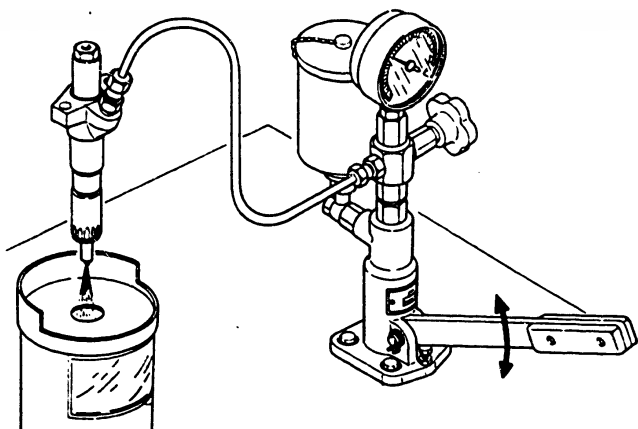
**Fig. 34** Installing the second spring, adjusting screw and nut

### **3. SECOND NOZZLE OPENING PRESSURE ADJUSTMENT**

- 1.** Install the second spring (11), adjusting screw (13), and nut (14). In this condition, the first pushrod contacts the second pushrod. (Fig. 34).

**Note:** Do not install the pre-lift adjusting shim (9) at this time.





**Fig. 35 Second nozzle opening pressure adjustment**

2. Set the second nozzle opening pressure to the adjusted value using the nozzle tester. (Fig. 35). After setting the pressure, secure the locknut (14).

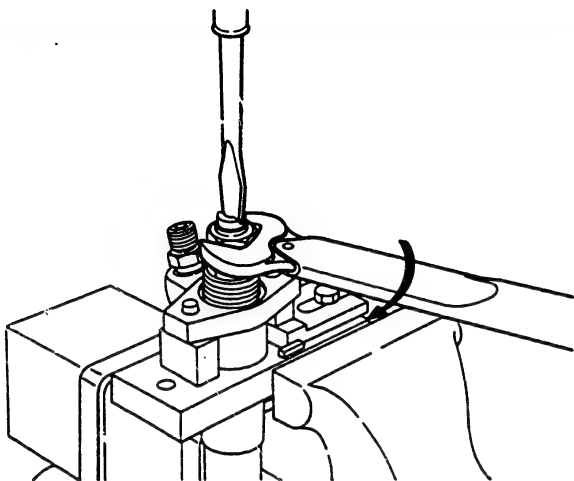
**Adjusted pressure: 253 - 259 kg/cm<sup>2</sup>.**

**C7**

**Second nozzle opening pressure adjustm.**

**Two-spring nozzle holder**





**Fig. 36 Tightening the locknut**

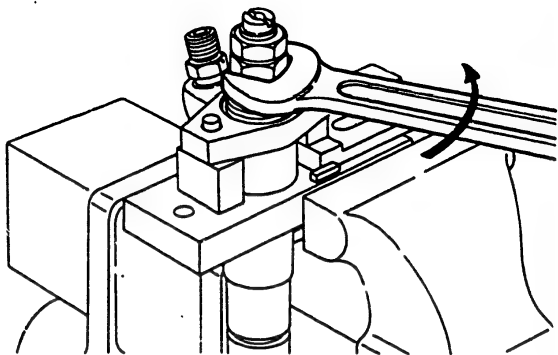
3. Tighten the locknut (14) to the specified torque, after removing the nozzle and nozzle holder from the nozzle tester. (Fig. 36).

Specified torque: 2 - 2.5 kg-m

4. Check the second nozzle opening pressure. If the pressure is not in the adjusted range, repeat adjustment.

**Note:** The pressure must be rechecked since the second nozzle opening pressure may change when the locknut (14) is tightened.





**Fig. 37 Set screw assembly removal**

#### **4. PRE-LIFT ADJUSTING SHIM INSTALLATION**

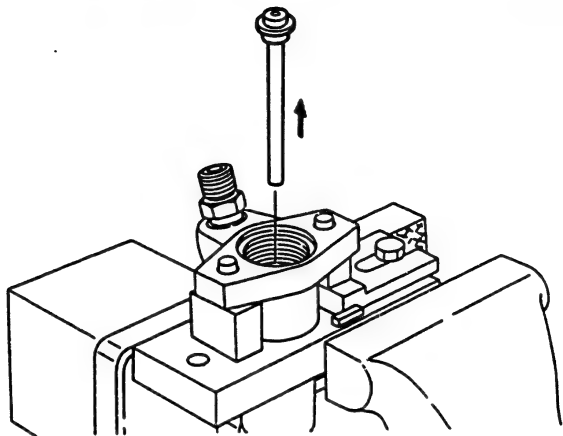
- 1. Remove the set screw assembly, which consists of the set screw (8), adjusting screw (13) and nut (14). (Fig. 37).**

**Note: Do not loosen the nut (14) at this time.**

**C9**

**Pre-lift adjusting shim installation**  
**Two-spring nozzle holder**





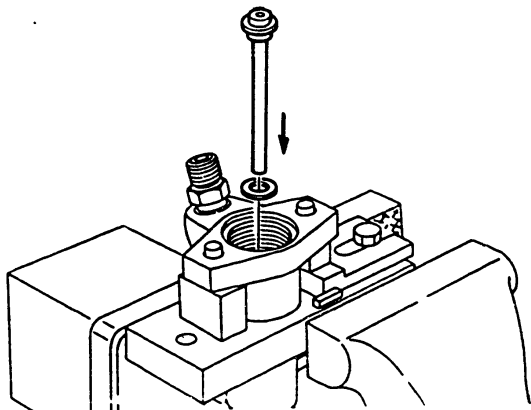
**Fig. 38 Second pushrod removal**

- 2. Remove the second pushrod.**

**C10**

Pre-lift adjusting shim installation  
Two-spring nozzle holder





**Fig. 39 Shim and second pushrod installation**

3. Install the pre-lift adjusting shims (9), selected in Step 2 - 10, in the nozzle holder between the spacer (7) and the second pushrod (10). (Fig. 39).

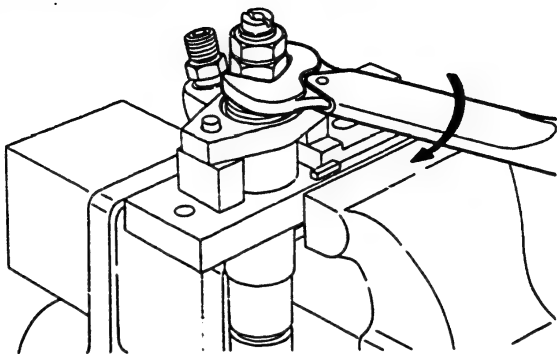
**Note:** Since this is the final installation, ensure the shim is clean.

**C11**

Pre-lift adjusting shim installation

Two-spring nozzle holder





**Fig. 40 Tightening the set screw**

4. Install the set screw assembly and tighten the set screw (8) to the specified torque. (Fig. 40).

**Specified torque: 5 - 6 kg-m**

**Note: Do not tighten the locknut (14) at this time. If it is tightened, the set value of the second nozzle opening pressure may change. Recheck the second nozzle opening pressure.**





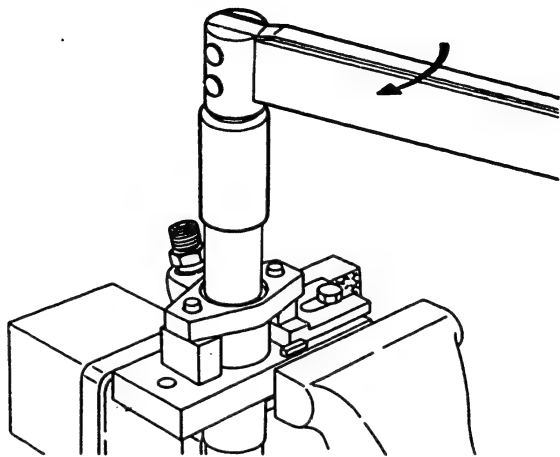


Fig. 41 Tightening the capnut

## 5. FINAL INSPECTION

1. Tighten the capnut (16) to the specified torque. (Fig. 41).

Specified torque: 4 - 5 kg-m

**C13**

Final inspection  
Two-spring nozzle holder



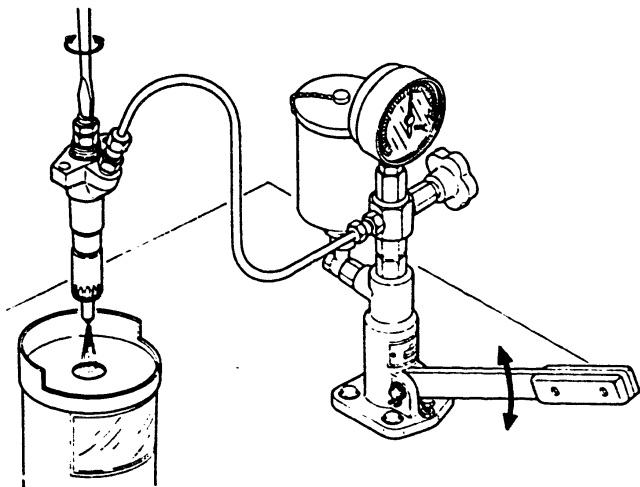


Fig. 42 Checking the first nozzle opening pressure, etc.

2. Fit the assembled two-spring nozzle holder to the nozzle tester, and check the first nozzle opening pressure, spray pattern, chatter and leakage, etc. (Fig. 42).

If any abnormalities are found, disassemble and inspect the nozzle holder. Then, repeat reassembly and adjustment.

Note: The second nozzle opening pressure can not be checked during this inspection.



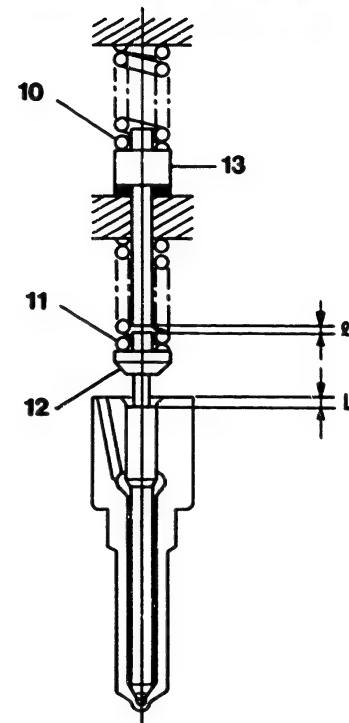
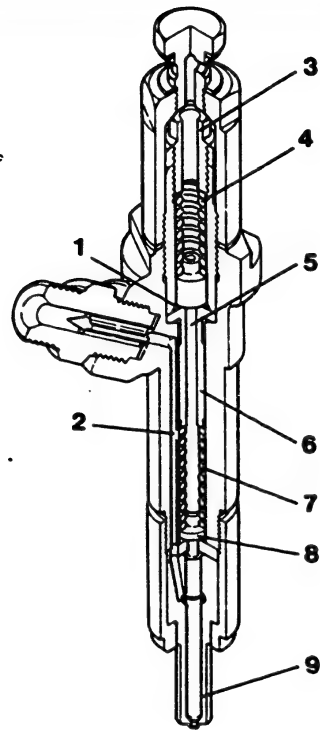


Fig. 43 KBDL II-P TYPE TWO-SPRING NOZZLE HOLDER

- |  |                    |
|--|--------------------|
| 1 = Shim (for adjusting pre-lift)                | 6 = Spacer         |
| 2 = Shim (for adjusting nozzle opening pressure) | 7 = First spring   |
| 3 = Adjusting screw                              | 8 = First pushrod  |
| 4 = Second spring                                | 9 = Nozzle         |
| 5 = Second pushrod                               | 10 = Second spring |

- |                              |
|------------------------------|
| 11 = First spring            |
| 12 = First pushrod           |
| 13 = Second pushrod          |
| L = Needle valve's full lift |
| Q = Needle valve's pre-lift  |

The KBDL II-P type two-spring nozzle holder's adjustment procedure is identical to that of the present KBL II-S type two-spring nozzle holder.

CONSTRUCCION

C15

Construction  
Two-spring nozzle holder



C16

Construction  
Two-spring nozzle holder



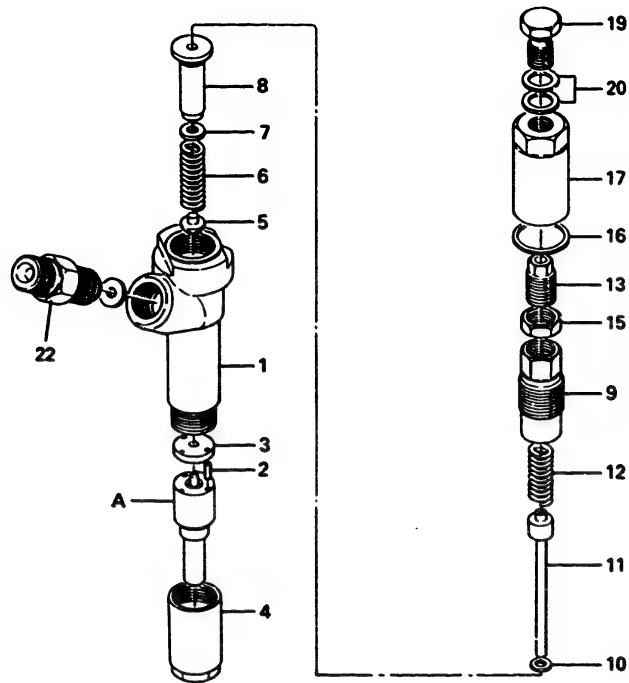


Fig. 44

No. Part Name

- 1 = Body (nozzle holder)
- 2 = Pin
- 3 = Spacer
- 4 = Retaining nut
- 5 = Pushrod (first)
- 6 = Spring (first)

EXPLODED VIEW

No. Part Name

- 7 = Shim
- 8 = Spacer
- 9 = Set screw
- 10 = Shim
- 11 = Pushrod (second)
- 12 = Spring (second)
- 13 = Adjusting screw

No. Part Name

- 15 = Nut
- 16 = Gasket
- 17 = Capnut
- 19 = Eyebolt
- 20 = Gasket
- 22 = Inlet connector
- A = Nozzle

C17

Exploded view  
Two-spring nozzle holder



C18

Exploded view  
Two-spring nozzle holder



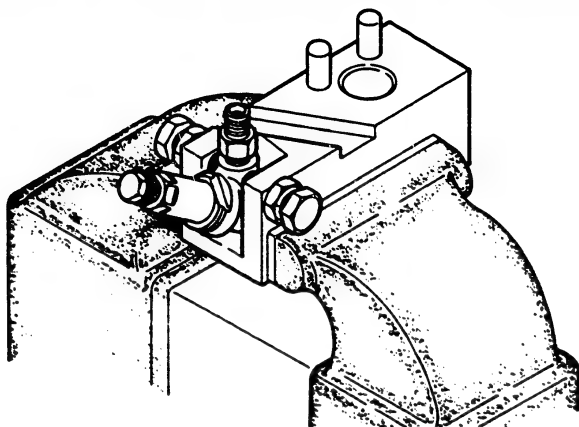


Fig. 45 Positioning the KBDL II-P type nozzle holder

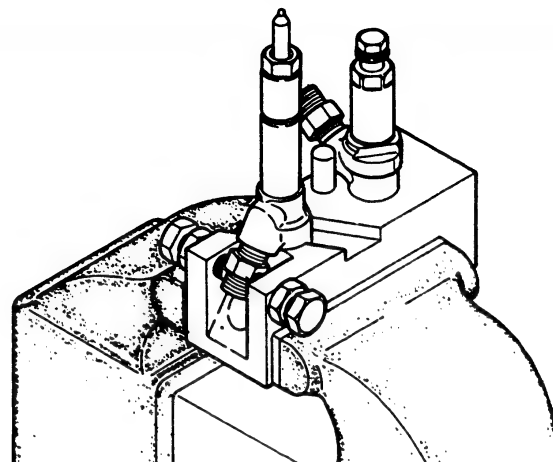


Fig. 46 Positioning the KBDL II-P type nozzle holder

**Plate Usage (Part No. KDEP 2654)**

The plate (Part No. KDEP 2654) is necessary for disassembly and reassembly of the KBDL II-P type two-spring nozzle holder.

Non-use of the plate may result in damage to the nozzle holder body. (Figs. 45 and 46).

**C19**

Exploded view

Two-spring nozzle holder



**C20**

Exploded view

Two-spring nozzle holder



## Adjusting shims

Thickness (mm)	Part No. *
0.90	150536-0200
0.80	150536-0100
0.70	150536-0000
0.60	150535-9900
0.58	150535-9800
0.56	150535-9700
0.54	150535-9600
0.52	150535-9500
0.50	150535-9400

\* Bosch Nr., see cross reference DKKC - Bosch, microfiche HB 30, HB 31.

**C21**

Exploded view

Two-spring nozzle holder



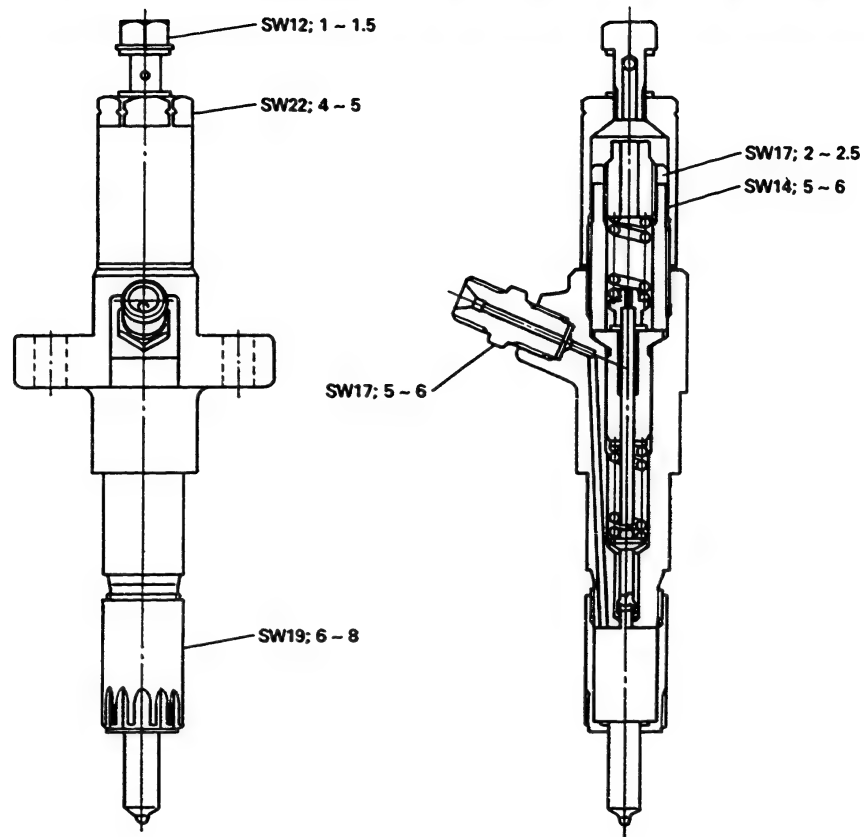


Fig. 47 KBL II-S

Unit: kg-m

Note: SW 17 means that the width across flats of a bolt (or nut) is 17 mm.

TIGHTENING TORQUES

**C22**

Tightening torques

Two-spring nozzle holder



**C23**

Tightening torques

Two-spring nozzle holder



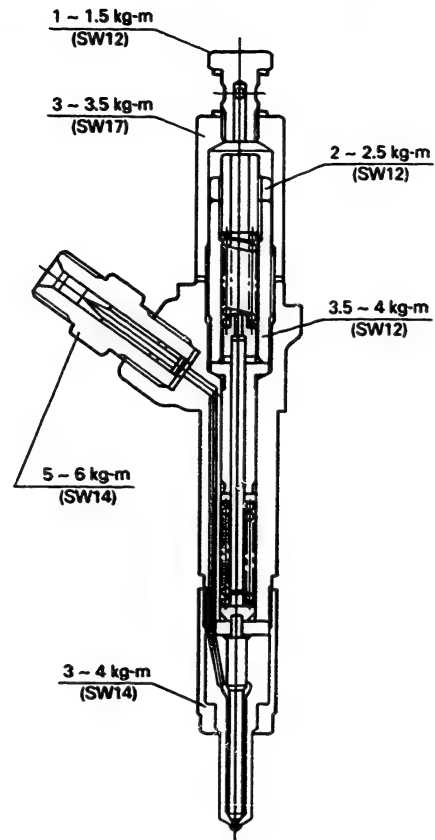


Fig. 48 KBDL II-P

Unit: kg-m

Note: SW 12 means that the width across flats of a bolt (or nut) is 12 mm.

**C24**

Tightening torques

Two-spring nozzle holder



**C25**

Tightening torques

Two-spring nozzle holder





# REPAIR INSTRUCTION

## PFR1KX TYPE INJECTION PUMP FOR HONDA GENERAL PURPOSE DIESEL ENGINE

Honda Motor Company has recently marketed the GD410 and GD320 model general purpose diesel engines equipped with the PFR1KX type injection pump. The specifications are given below.

### 1. Application

General purpose

### 2. Engine Specifications

MODEL ITEM	GD410	GD320
Type	Air-cooled; 4cycle; direct injection type	Air-cooled; 4cycle; direct injection type
Total displacement	411cc	317cc
Rated output	8PS / 3,600rpm	6PS / 3,600rpm
Maximum torque	2.1kg·m / 2,500rpm	1.6kg·m / 2,500rpm

### 3. Injection Pump Specifications

Pump assembly No.                    104135-1000 [ 16300-ZG3-003 ]  
(NP-PFR1KX60/1NP1)

[       ] Honda No.; (       ) Bosch type No.

**D1**

Specifications

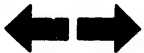
Two-spring nozzle holder



**D2**

Specifications

Two-spring nozzle holder



#### 4. Nozzle and Nozzle Holder Specifications

Nozzle, nozzle holder assembly No.	105118-7020	[ 16410-ZG3-003 ]
Nozzle holder part No.	105048-2080	
Nozzle part No.	105017-0790	[ 16431-ZG3-003 ] ( NP-DLLA155PN079 )
Nozzle holder body stamping	"48-2080"	
	[       ]	Honda No.; (       ) Bosch type No.

#### ■ Specifications

##### *First nozzle opening pressure*

- Specified value : 180 kg/cm<sup>2</sup>
- Adjusted value : 185 ~ 195 kg/cm<sup>2</sup>

##### *Second nozzle opening pressure*

- Specified value : 210 kg/cm<sup>2</sup>
- Adjusted value : 293 ~ 308 kg/cm<sup>2</sup>  
(Opened system)
- Adjusted value : 226 ~ 236 kg/cm<sup>2</sup>  
(Nozzle covered system) (When needle valve lift is 0.05 mm)

*Needle valve lift* : 0.2 mm

*Pre-lift* : 0.055 mm

**D3**

Specifications

Two-spring nozzle holder



**D4**

Specifications

Two-spring nozzle holder



**NOTE**

- 1) The opened system is a system of adjusting the nozzle opening pressure while the adjustment retaining nut is removed.
- 2) The nozzle covered system is a system of adjusting the nozzle opening pressure while the adjustment retaining nut is installed.

Although this nozzle holder utilizes the KBDLII-P type 2-spring nozzle holder, the adjustment procedures and tools differ from those used for current 2-spring nozzle holders. Refer to item 5 for details.

**D5**

Specifications

Two-spring nozzle holder



**D6**

Specifications

Two-spring nozzle holder



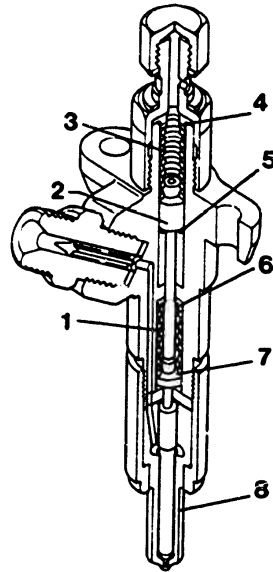
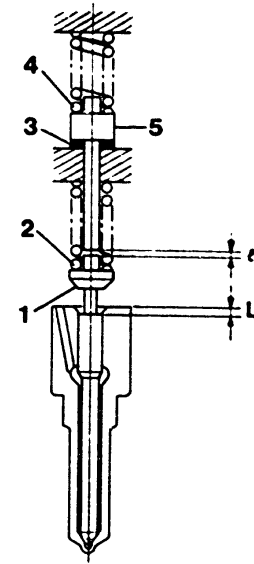


Fig. 1

### 5. KBDLII-P Type Two-Spring Nozzle Holder 5-1 Construction

- 1 = First spring
- 2 = Pushrod
- 3 = Second spring
- 4 = Shim  
(for opening pressure adjustment)
- 5 = Shim  
(for pre-lift adjustment)
- 6 = Shim  
(for opening pressure adjustment)
- 7 = Spring seat
- 8 = Nozzle



- 1 = Spring seat
- 2 = First spring
- 3 = Pre-lift adjusting shim
- 4 = Second spring
- 5 = Pushrod

L = Total needle valve lift  
l = Needle valve pre-lift

D7

Construction

Two-spring nozzle holder



D8

Construction

Two-spring nozzle holder



## 5-2 Special Tools

In addition to general tools (spanner, socket wrench etc.), the following special tools are necessary for disassembly, reassembly and adjustment.

Key No.	Tool Name	Part No.	Remarks
1	Dial gauge	1 687 233 010	Range : 0 ~ 5 mm ( $\times 0.01$ mm)
2	Connector assembly	KDEP 2659/1	
3	Pin	KDEP 2659/2	$l = 45$ mm
4	Retaining nut	KDEP 2659/3	
4/2	Gasket	KDEP 2659/3	For retaining nut bolt
5	Gasket	KDEP 2659/3	For retaining nut
6	Plate	KDEP 2660	For holding nozzle holder
7	Torque spanner	Commercially available	For tightening connector assembly (SW17); Tightening torque: 2.0 ~ 2.5 kg·m

**Note:** In addition to the above special tools, a nozzle tester (105785-1010; gauge pressure: 500 kg/cm<sup>2</sup>) and cleaning tools for the DLLA-P type nozzle are necessary.

**D9**

Special tools

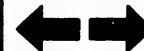
Two-spring nozzle holder



**D10**

Special tools

Two-spring nozzle holder



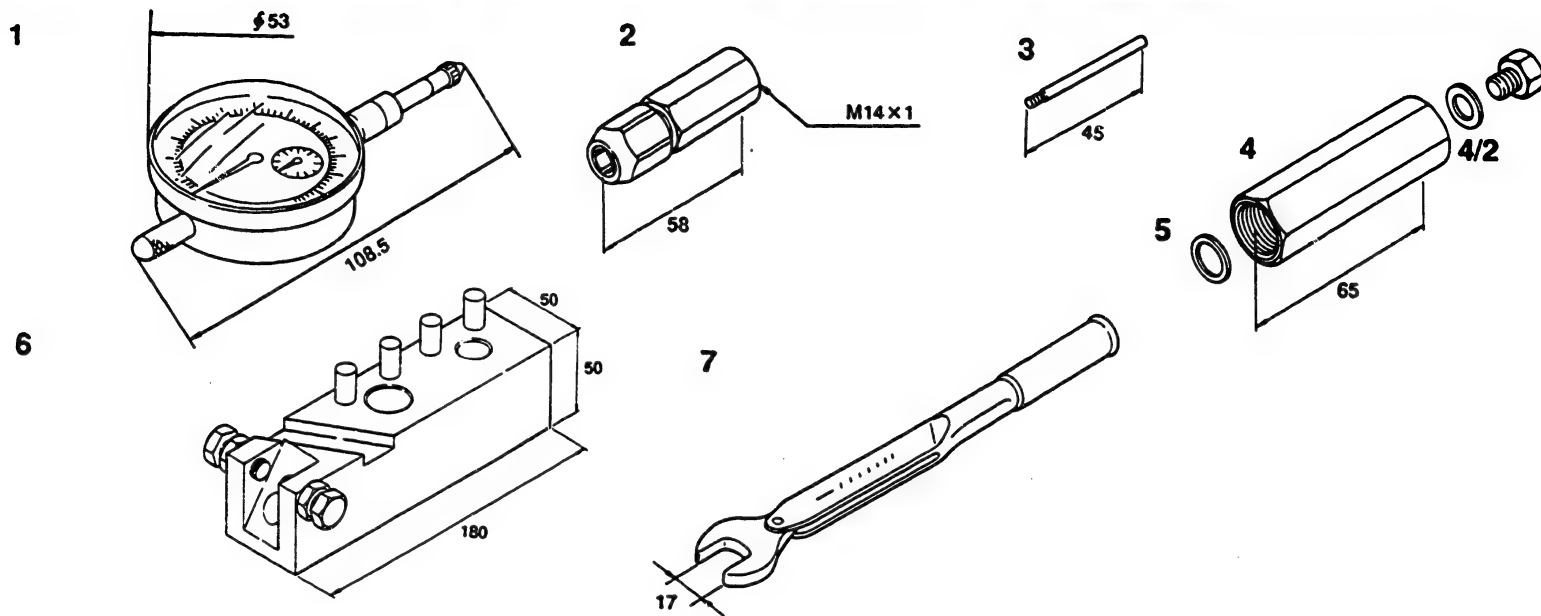
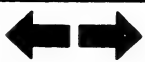


Fig. 2

5-2 Special Tools

D11

Special tools  
Two-spring nozzle holder



D12

Special tools  
Two-spring nozzle holder



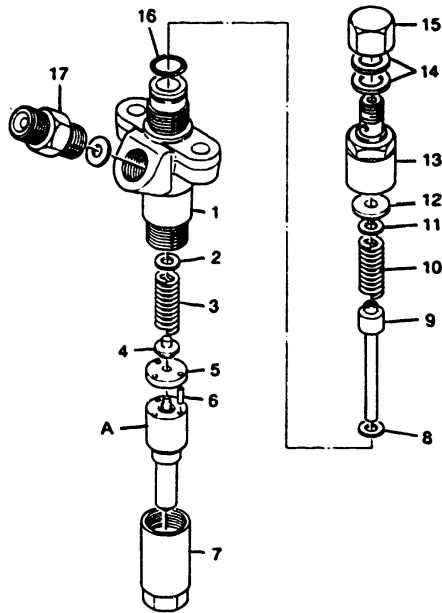


Fig. 3

### 5-3 Disassembly, Reassembly and Adjustment

#### ■ Disassembly

Key No.	Part Name	Key No.	Part Name
1	Body (nozzle holder)	10	Spring (second)
2	Shim	11	Shim
3	Spring (first)	12	Spring seat
4	Spring seat	13	Cap nut
5	Spacer	14	Gasket
6	Pin	15	Nut
7	Retaining nut	16	O-ring
8	Shim	17	Inlet connector
9	Pushrod	A	Nozzle

**D13**

Disassembly

Two-spring nozzle holder



**D14**

Disassembly

Two-spring nozzle holder





## ■ Reassembly and Adjustment

Adjustment is performed during re-assembly in the sequence shown below. As adjustment of the two-spring nozzle holder's pre-lift is made in hundredths of a millimeter, be sure to wash all components in clean cleaning liquid (light oil etc.) to remove all dirt and foreign matter before adjustment.

The numbers in brackets following part names are their key numbers in the Fig. 3. The numbers in brackets following tool names indicate part numbers or specifications.

**D17**

Reassembly and adjustment  
Two-spring nozzle holder



## PROCEDURE

- 1 **SETTING THE DIAL GAUGE'S ZERO POINT** ----- Adjust the dial gauge's "0" point to facilitate selection of the pre-lift adjusting shim.
- 2 **FIRST NOZZLE OPENING PRESSURE ADJUSTMENT** ----- Adjust the first nozzle opening pressure using shim (2).
- 3 **TEMPORARY ADJUSTMENT OF SECOND NOZZLE OPENING PRESSURE** ----- With the adjustment retaining nut screw removed (opened system), adjust the second nozzle opening pressure using shim (11).
- 4 **SELECTION OF PRE-LIFT ADJUSTING SHIM** ----- Select a pre-lift adjusting shim (8).
- 5 **CONFIRMATION OF NEEDLE VALVE'S FULL LIFT** ----- Measure the needle valve's full lift for reference when confirming pre-lift.
- 6 **INSTALLATION OF PRE-LIFT ADJUSTING SHIM** ----- Install the shim (8) selected in step 4 above.  
**Note: Shim (8) must not be installed during steps 1 ~ 5.**
- 7 **PRE-LIFT CONFIRMATION** ----- Confirm that the shim (8) selected in step 4 above is a suitable thickness.
- 8 **CONFIRMATION OF SECOND NOZZLE OPENING PRESSURE** ----- With the adjustment retaining nut screw installed (nozzle covered system), confirm the second nozzle opening pressure.
- 9 **FINAL INSPECTION** ----- Confirm the condition of the fuel spray etc. with the nozzle and nozzle holder assembled.

**D18**

Reassembly and adjustment  
Two-spring nozzle holder



**D19**

Reassembly and adjustment  
Two-spring nozzle holder



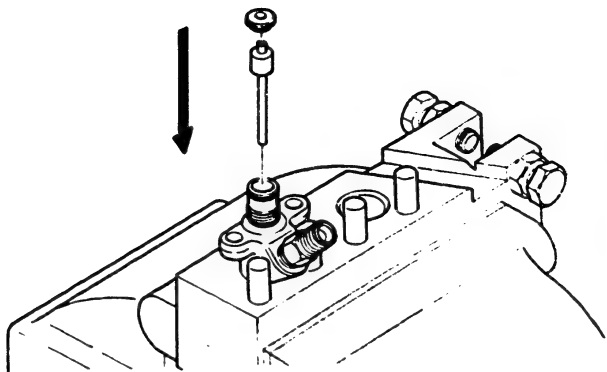


Fig. 4

### ADJUSTING THE DIAL GAUGE'S ZERO POINT

1. Position the nozzle holder on the plate (KDEP 2660) with the cap nut side up.
2. Insert the pushrod (9) and spring seat (12) into the nozzle holder.



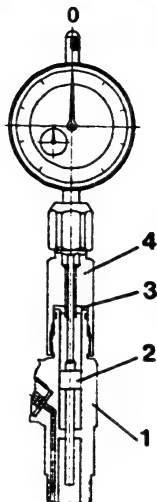


Fig. 5

1 = Nozzle holder  
2 = Pushrod

3 = Spring seat  
4 = Connector

3. Fix the connector assembly (KDEP 2659/1) to the dial gauge (1 687 233 010)

**Note:** Use a 45mm pin (KDEP 2659/2)

4. Position the connector assembly (with dial gauge) as shown in Figure 5, and tighten it using a torque spanner. Then adjust the dial gauge to "0".

**Tightening torque:** 2.0 ~ 2.5 kg·m



**Adjusting the dial gauge's zero point  
(cont' d)**

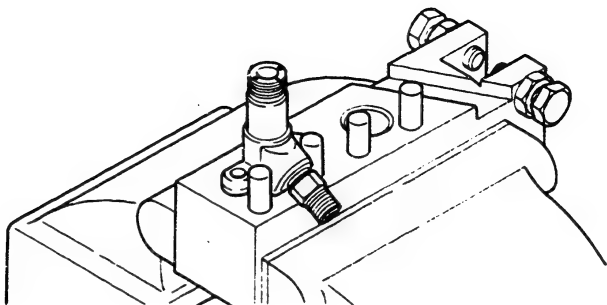
5. Using a spanner, loosen and remove the connector assembly (with dial gauge), taking care not to disturb the dial gauge's "0" setting.
6. Remove the pushrod (9) and spring seat (12) from the nozzle holder.

**D22**

**Reassembly and adjustment**

**Two-spring nozzle holder**



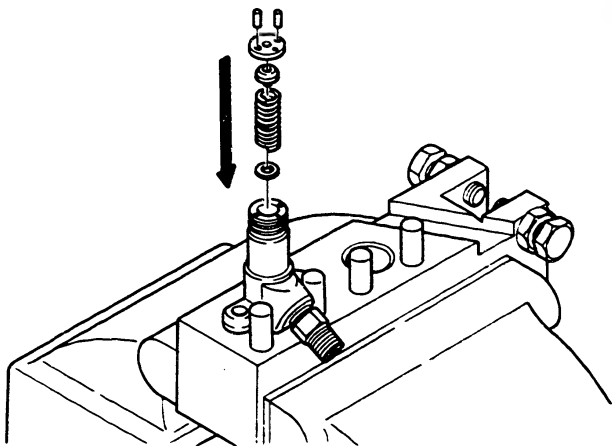


**Fig. 6**

### **FIRST NOZZLE OPENING PRESSURE ADJUSTMENT**

1. Position the nozzle holder on the plate (KDEP 2660) with the cap nut side down.

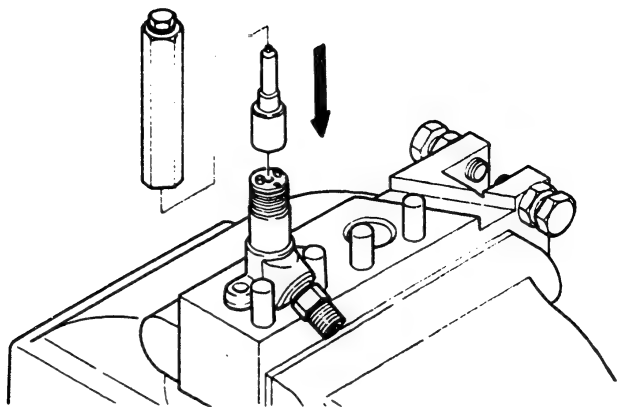




**Fig. 7**

2. Install the first nozzle opening pressure adjusting shim (2), the No.1 spring (3), the spring seat (4), the spacer (5), and the pin (6) in the nozzle holder.



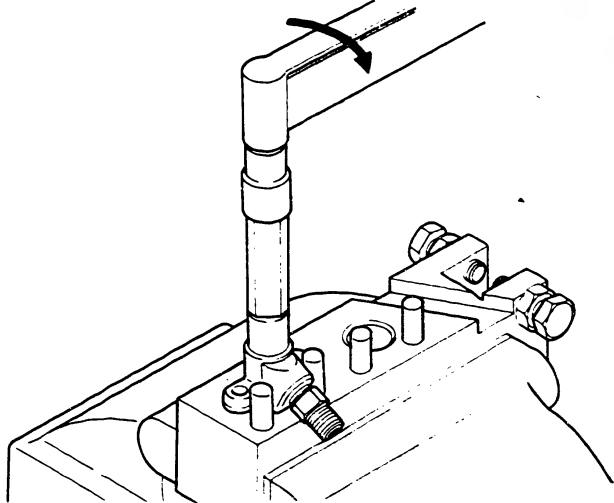


**Fig. 8**

3. Fix the nozzle to the nozzle holder using the adjustment retaining nut (KDEP 2659/3).







**Fig. 9**

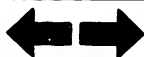
4. Tighten the adjustment retaining nut using a socket wrench (SW17) and a torque wrench.

**Tightening torque: 3.0~4.0 kg-m**

**D26**

Reassembly and adjustment

Two-spring nozzle holder



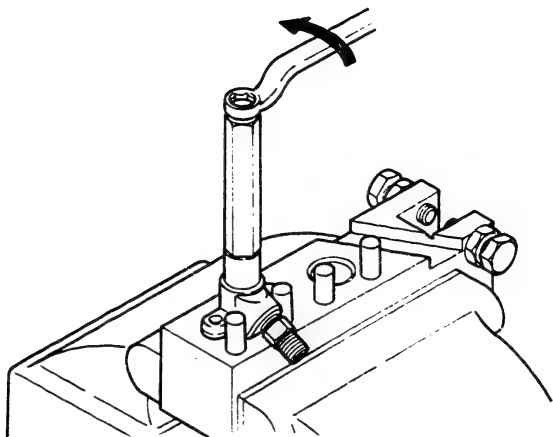


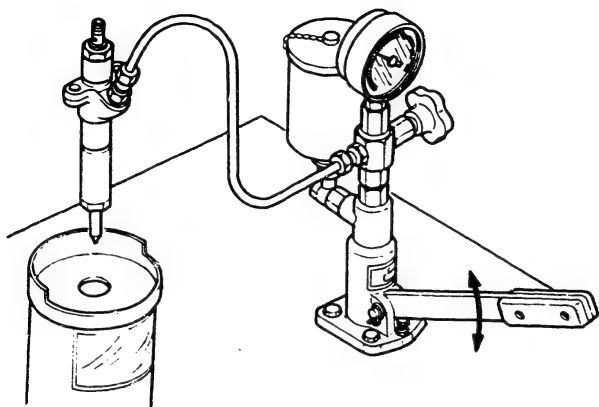
Fig. 10

5. Remove the screw from the adjustment retaining nut.

**D27**

Reassembly and adjustment  
Two-spring nozzle holder





**Fig. 11**

6. Adjust the first nozzle opening pressure using the nozzle tester (0 684 200 704).

**Adjusted pressure: 185 ~ 195 kg/cm<sup>2</sup>**

If the opening pressure is not as specified, replace the shim (2) and readjust. Adjusting shims are shown in Table 1.



Thickness (mm)	* Part No.
0.50	150535-9400
0.51	150536-2300
0.52	150535-9500
0.53	150536-2400
0.54	150535-9600
0.55	150536-2500
0.56	150535-9700
0.57	150536-2600
0.58	150535-9800
0.59	150536-2700
0.60	150535-9900
0.70	150536-0000
0.80	150536-0100
0.90	150536-0200

**Table 1** \* Bosch Nr., see cross reference ZEXEL - Bosch, microfiche HB 30, HB 31.

### **Pre-lift and Opening Pressure Adjustment Shims**

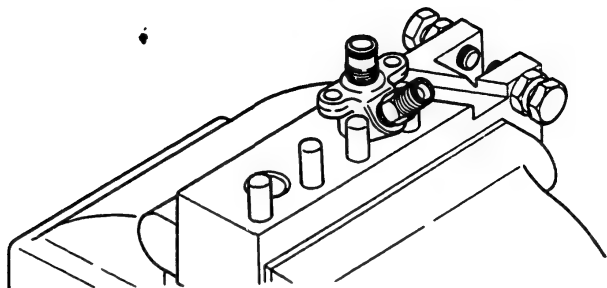
Table 1 shows the shims used for pre-lift, first and second nozzle opening pressure adjustment.

**E1**

Reassembly and adjustment

Two-spring nozzle holder





**Fig. 12**

**TEMPORARY ADJUSTMENT OF  
SECOND NOZZLE OPENING  
PRESSURE**

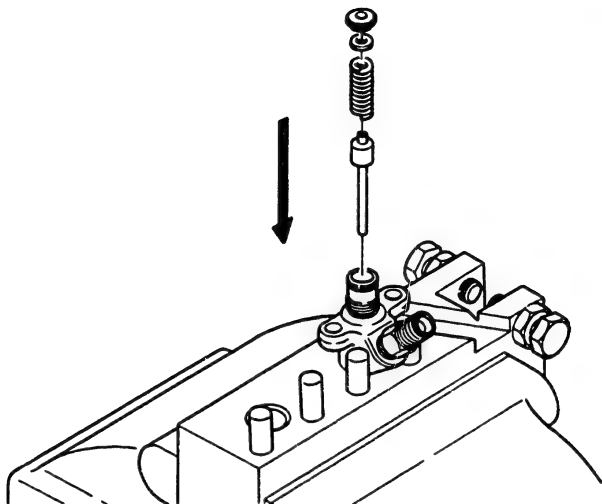
1. Position the nozzle holder on the plate (KDEP 2660).

**E2**

Reassembly and adjustment

Two-spring nozzle holder

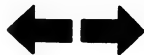


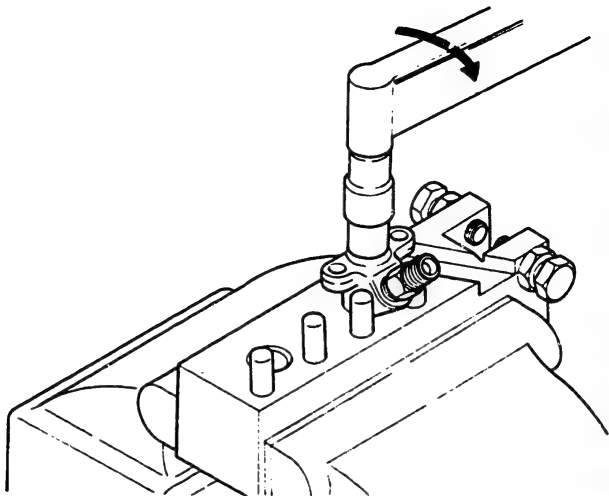


**Fig. 13**

2. Install the pushrod (9), the second spring (10), the second nozzle opening pressure adjusting shim (11) and the spacer (12) in the nozzle holder.

**Note: Do not install the O-ring (16) and pre-lift adjusting shim (8) at this time.**



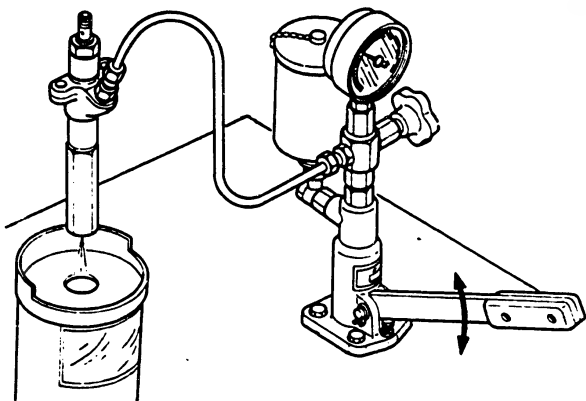


**Fig. 14**

3. Tighten the cap nut (13) using a socket wrench (SW14) and a torque wrench.

**Tightening torque: 2.0 ~ 2.5 kg·m**





**Fig. 15**

4. Temporarily adjust the second nozzle opening pressure using the nozzle tester (0 684 200 704).

**Adjusted pressure: 293 ~ 308 kg/cm<sup>2</sup>**

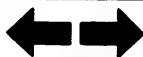
At this time use the adjusting pressure specified for adjustment with the retaining nut screw removed (opened system).

If the pressure is not as specified, replace the shim (11) and readjust. Adjusting shims are shown in Table 1.

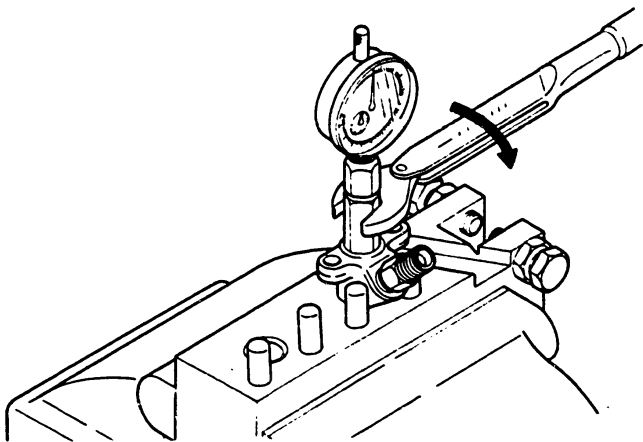
**E5**

Reassembly and adjustment

Two-spring nozzle holder







**Fig. 16**

### **PRE-LIFT SHIM SELECTION**

1. Install the screw in the end of the adjustment retaining nut.
2. Remove the cap nut and tighten the connector assembly (with dial gauge), which was used to set the dial gauge's "0" position in procedure 1, using a torque spanner.

**Tightening torque: 2.0 ~ 2.5 kg-m**

**E6**

Reassembly and adjustment

Two-spring nozzle holder



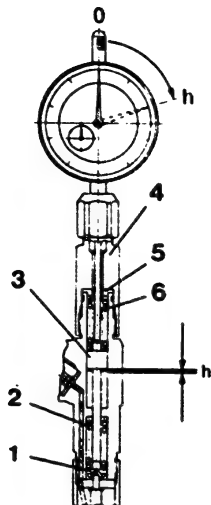


Fig. 17

- |                  |                   |
|------------------|-------------------|
| 1 = Spring seat  | 4 = Connector     |
| 2 = First spring | 5 = Spring seat   |
| 3 = Pushrod      | 6 = Second spring |

- Record the value "h" shown on the dial gauge.
- Calculate the thickness (T) of the pre-lift shim to be installed, as shown below.

$$T = (h + \ell) \pm 0.005 \quad \text{unit: mm}$$

T : shim thickness

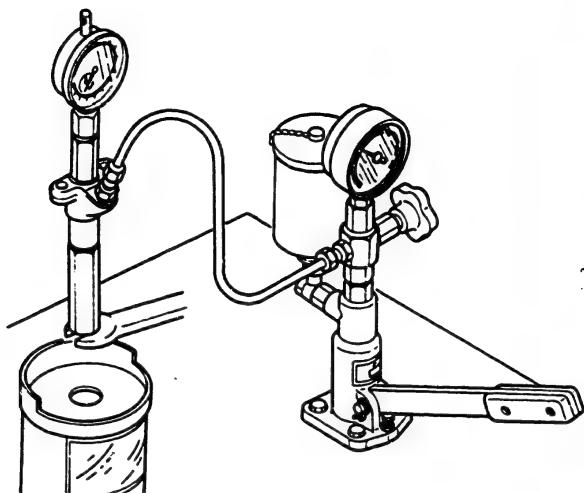
h : dial gauge reading explained in step 3 above

$\ell$  : pre-lift (specified value: 0.055 mm)

**E7**

Reassembly and adjustment  
Two-spring nozzle holder





**Fig. 18**

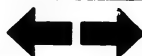
### **CONFIRMATION OF NEEDLE VALVE'S FULL LIFT**

1. Fix the nozzle holder to the nozzle tester and adjust the dial gauge's "0" position.
2. Operate the nozzle tester, purge air from the inside of the retaining nut and confirm that no fuel leaks from the nozzle holder.

**E8**

Reassembly and adjustment

Two-spring nozzle holder



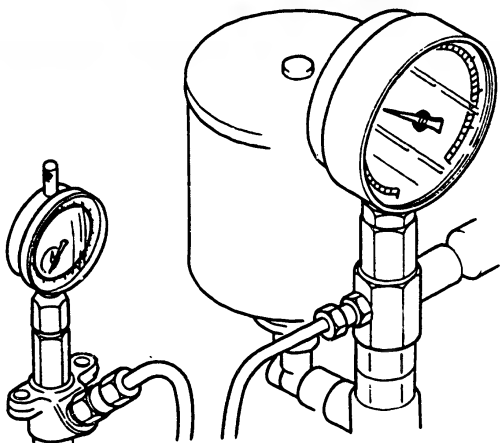
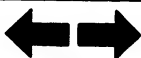


Fig. 19

3. Operate the nozzle tester, increase the in-line pressure to  $350 \sim 450 \text{ kg/cm}^2$  so that the nozzle's needle valve moves through its full stroke, and then measure the full lift "L" from the dial gauge.

**E9**

Reassembly and adjustment  
Two-spring nozzle holder



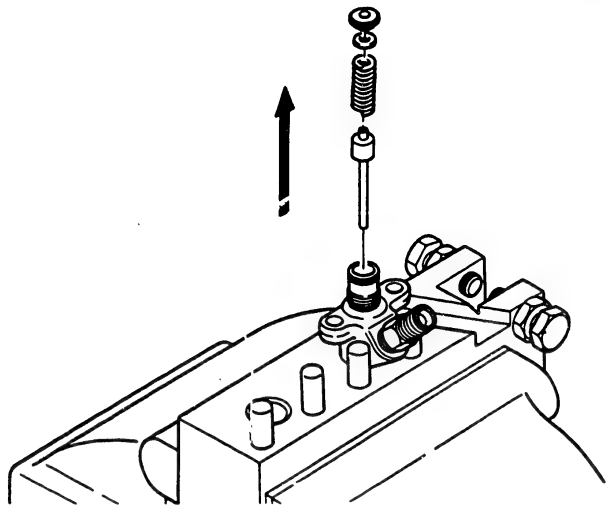


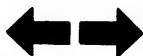
Fig. 20

### PRE-LIFT SHIM INSTALLATION

1. Remove the connector assembly (with dial gauge), and then the spring seat (12), the shim (11), the second spring (10) and the pushrod (9).

**E10**

Reassembly and adjustment  
Two-spring nozzle holder



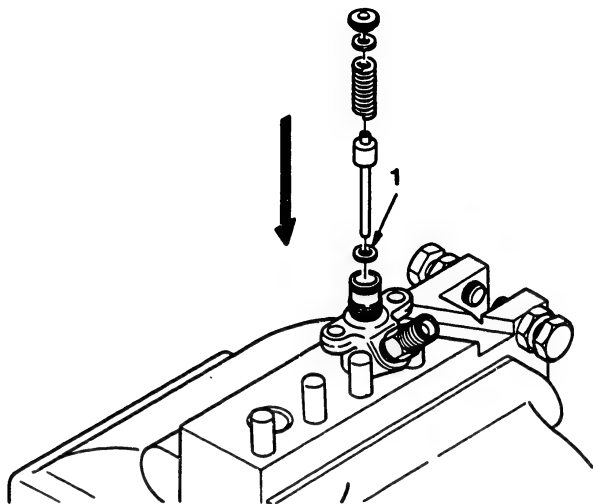


Fig. 21

1 = Shim for pre-lift adjustment

2. Install the previously selected pre-lift adjusting shim (8) and pushrod (9), and the second spring (10), the shim (11) and the spring seat (12).
3. Install the connector assembly (with dial gauge), tighten it to the specified torque, and adjust the dial gauge's "0" position.

**Tightening torque: 2.0 ~ 2.5 kg·m**



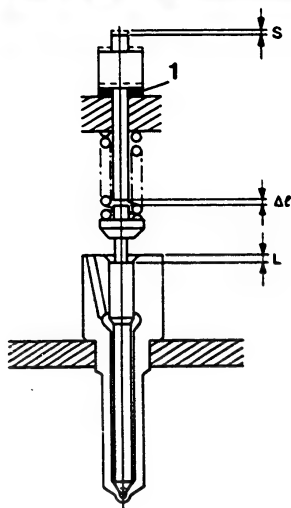


Fig. 22

1 = Shim for pre-lift adjustment

### PRE-LIFT CONFIRMATION

Fix the nozzle holder to the nozzle tester and increase the in-line pressure to 350 ~ 450 kg/cm<sup>2</sup> so that the needle valve moves through its full stroke.

Measure the lift "S" from the dial gauge.

Pre-lift value  $\Delta\ell$  is shown by the following formula:

**E12**

Reassembly and adjustment

Two-spring nozzle holder



$$\Delta\ell = L - S$$

If  $\Delta\ell$  does not satisfy the following i.e.

$$\ell - 0.01 \leq \Delta\ell \leq \ell + 0.01,$$

replace the pre-lift shim (8), and remeasure lift "S" until pre-lift  $\Delta\ell$  is equal to the specified lift  $\ell \pm 0.01$ .

The thickness of the replacement shim can be found using the following formula.

$$T_1 = \{ T + (\ell - \Delta\ell) \} \pm 0.005$$

unit: mm

$T_1$ : replacement shim thickness

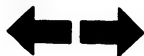
T : installed shim thickness

$\ell$  : specified pre-lift

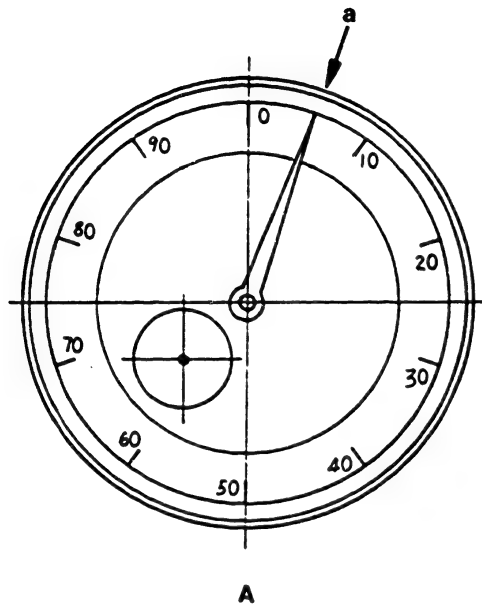
$\Delta\ell$  : measured pre-lift

L : needle valve's full lift (measured value)

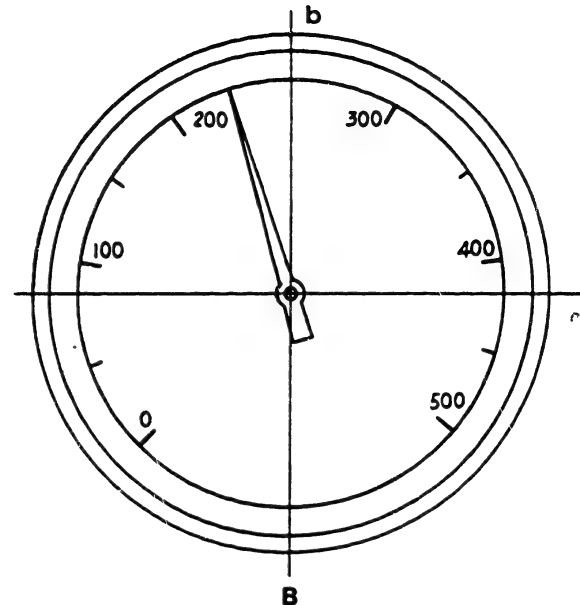
S : pre-lift subtracted from needle valve lift (measured value)







A



B

Fig. 23

a = When needle valve lift is 0.05 mm

A = Dial gauge

b = Read pressure gauge pressure

B = Pressure gauge

**CONFIRMATION OF SECOND NOZZLE OPENING PRESSURE (NOZZLE COVERED SYSTEM)**

1. After conforming the pre-lift, again increase the in-line pressure to 350 - 450 kg/cm<sup>2</sup> so that the nozzle's needle valve moves through its full stroke.
2. When the nozzle's needle valve is in the full-lift position, release the nozzle tester's handle. The in-line pressure will then begin to decrease, as will the needle valve position (as indicated on the dial gauge).

**E14**

Reassembly and adjustment  
Two-spring nozzle holder



**E15**

Reassembly and adjustment  
Two-spring nozzle holder



**Confirming of second nozzle opening pressure  
(nozzle covered system)**

(cont' d)

3. As soon as the needle valve lift (indicated on the dial gauge) falls to the specified value, measure the pressure indicated on the pressure gauge. Confirm that the pressure is as specified.(Fig. 23)

This specified value is the value specified for adjustment with the retaining nut screw installed (nozzle covered system).

**Adjusted pressure : 226~236 kg/cm<sup>2</sup>  
(When needle valve lift is 0.05 mm)**

4. If not as specified, replace the second nozzle opening pressure adjusting shim (11), and after adjusting the opening pressure with the retaining nut's screw removed (opened system), recheck the pressure with the screw installed (nozzle covered system).

Any pre-lift adjustments or confirmations are unnecessary at this time.



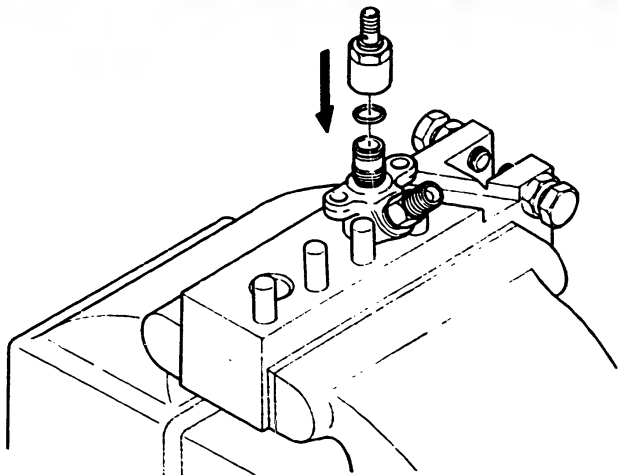


Fig. 24

### FINAL INSPECTION

1. Remove the connector assembly.
2. Remove the adjustment retaining nut and install the nozzle holder's retaining nut (7). Tighten it to the specified torque.

**Tightening torque: 3.0 ~ 4.0 kg-m**

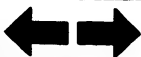
3. Install the O-ring (16) and cap nut (13), and tighten it to the specified torque.

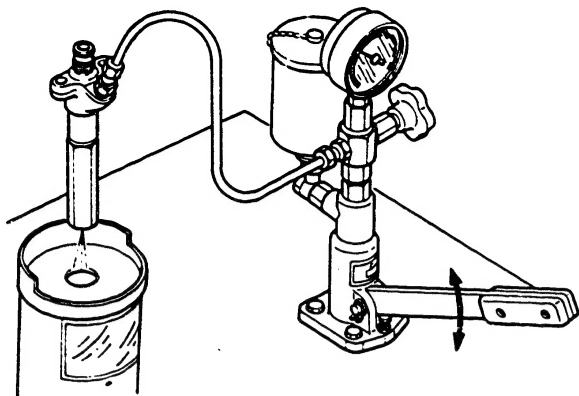
**Tightening torque: 2.0 ~ 2.5 kg-m**

**E17**

Reassembly and adjustment

Two-spring nozzle holder





**Fig. 25**

4. Fix the nozzle holder to the nozzle tester and check the first nozzle opening pressure, spray pattern, leakage etc.

**E18**

Reassembly and adjustment

Two-spring nozzle holder



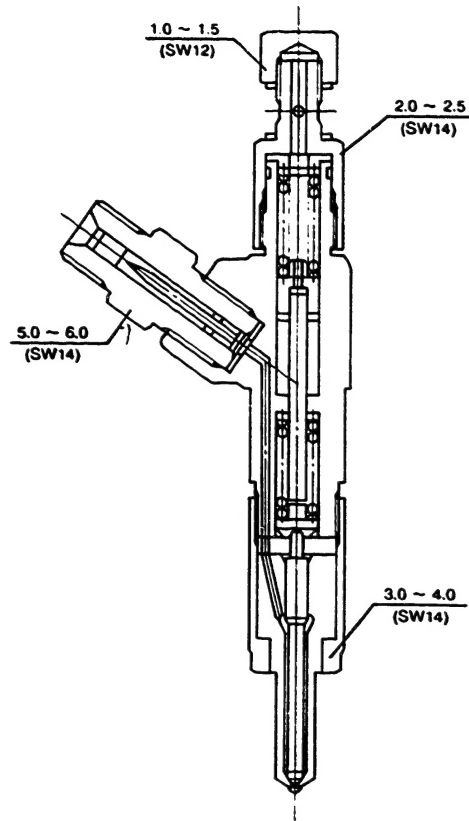



Fig. 26

Unit: kgm

5-4 TIGHTENING TORQUES

<b>E19</b>	Tightening torques	
	Two-spring nozzle holder	

<b>E20</b>	Tightening torques	
	Two-spring nozzle holder	

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